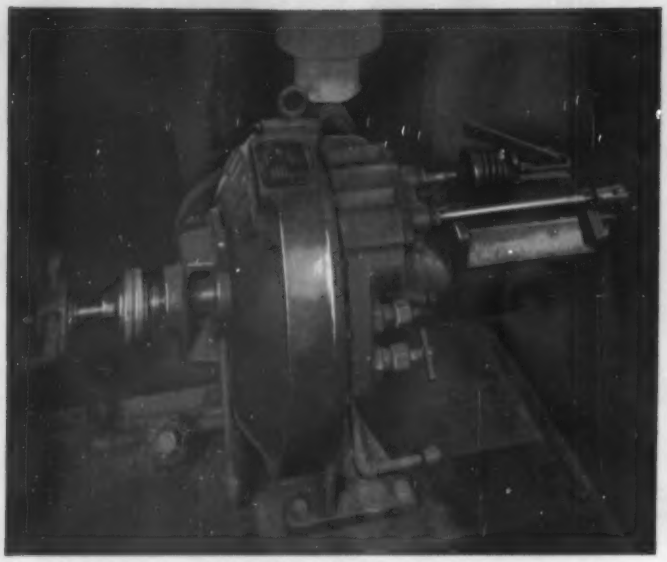
MAY 1955

Power Engineering

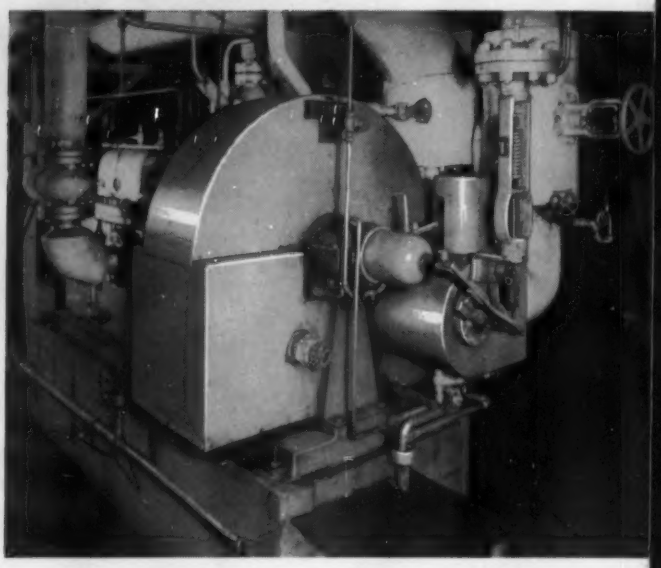
So – You're Going to Overhaul Your Turbine Generator – 61
What Some Modern Diesels Cost – 64
How Kaiser Rectifies Power for Potlines – 66
America's Only All-Power Conference Sets New Records – 69
Heat Pump Goes to Work in Sewage Treatment – 78
New Zeolites Separate Gas or Liquid Mixtures by Molecule Size – 81
Are Cyclone Furnaces Suitable for Small Boilers? – 82
You Can Get Positive Multiposition Control with Air Cylinders – 85
POWER ENGINEERING'S News Reel – 86
How Power Engineers Learn Work Simplification – 88
Consolidated Edison to Build Nuclear Power Plant – 91
Could Your Main Condensers Pass This Aptitude Test Today? – 92
Stainless Steel Coal Ducts Stop Trouble in Maintenance and Operation – 95
Armored Cable – How It Helps Cut Costs – 96
How Sulfur Content of Coal Relates to Ash Fusion Characteristics – 98
Two-Way Radio Dispatches Norton's Thermos-Bottle Locomotives – 102

REGULAR DEPARTMENTS

Engineers' Preview 3
Letters to the Editors 5
Here's What They Tell Us 6
Helpful Bulletins 25
Construction News 40
Equipment News 42
Power Engineering Handbook 106
Obituaries 116
Catalog Library 117
Readers' Service Post Cards 117
Advertisers' Index 132
Circulation of This Issue 36,220

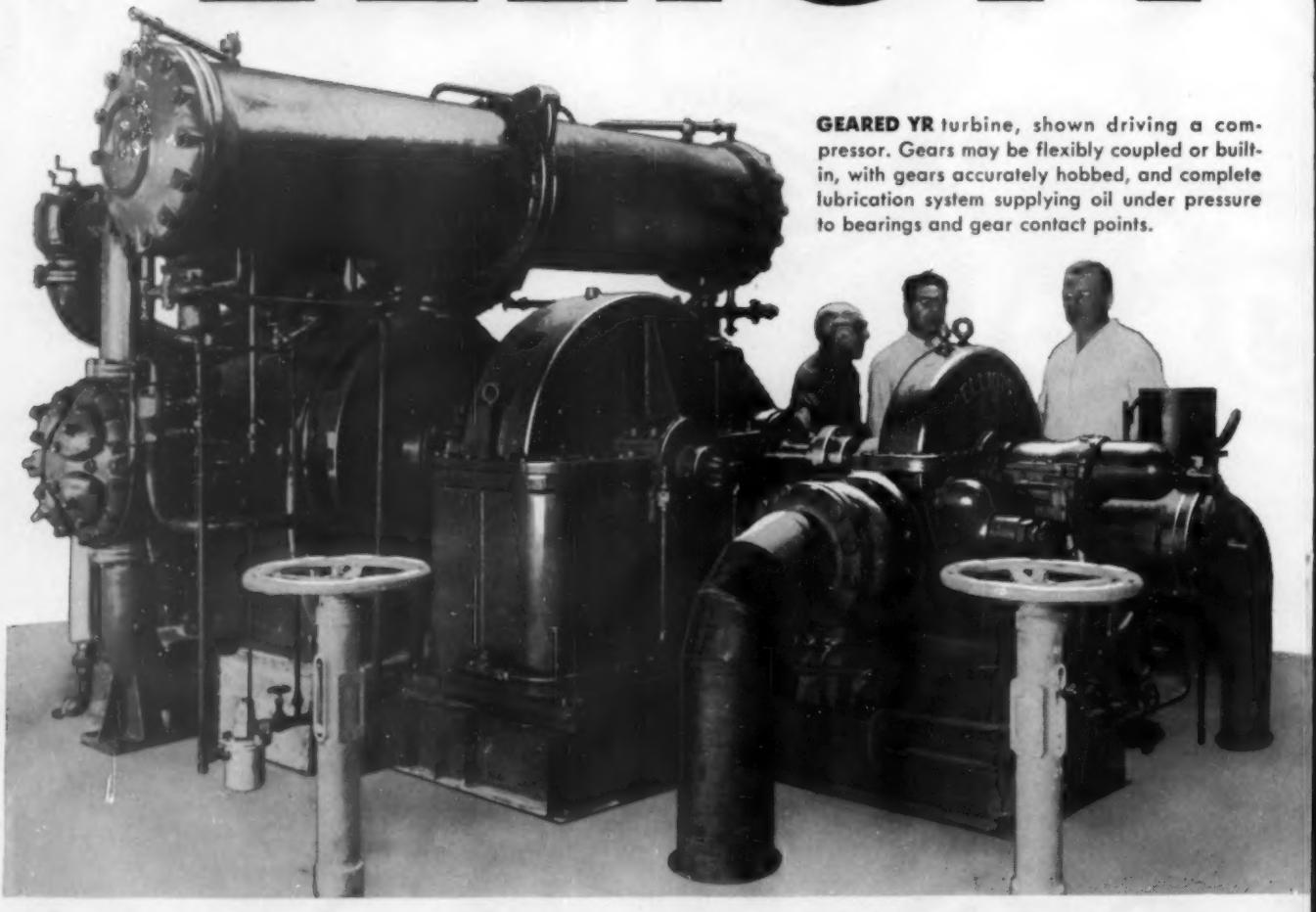


TYPE JR, shown driving a small pump. This is a simplified turbine design of rugged and reliable construction for low horsepower requirements and minimum first cost. Rated up to 45 hp, 4000 rpm. Maximum steam conditions—250 psig, 500 F. and 50 psig exhaust pressure.

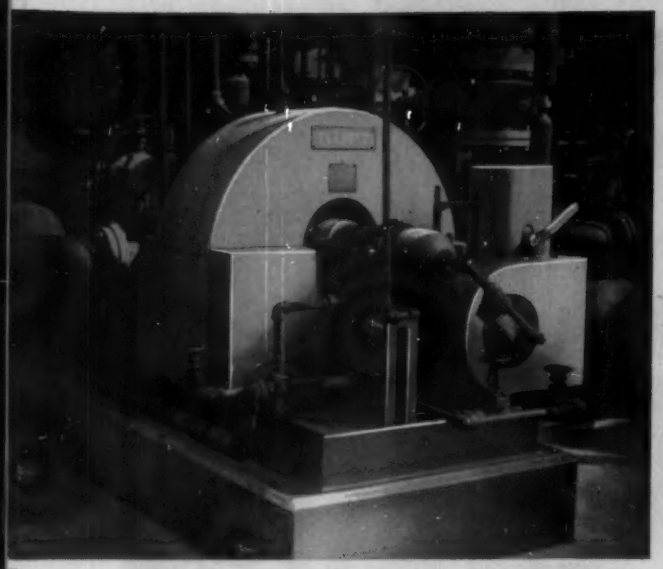


TYPE YR, here driving a boiler-feed pump. This is the standard Elliott mechanical drive turbine preferred all over industry. Five sizes — capacities up to 2000 hp, speeds to 7000 rpm. Steam conditions up to 600 psig, 750 F. and 75 psig exhaust pressure.

ELLIOTT



GEARED YR turbine, shown driving a compressor. Gears may be flexibly coupled or built-in, with gears accurately hobbed, and complete lubrication system supplying oil under pressure to bearings and gear contact points.



HIGH BACK-PRESSURE turbine, shown driving a boiler-feed pump in an oil refinery. These turbines using basic wearing parts of the standard YR, but with extra heavy casing and readily removable extra-packing glands. Good for exhaust pressures up to 250 psig.

MULTISTAGE turbine, shown driving a compressor. Photo shows single-valve turbine, but multi-valve designs can be furnished. Speeds up to 11,000 rpm, steam conditions up to 850 psig, 850 F. Condensing and noncondensing ratings 400 hp and up. Custom-built to your requirements.

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WHATEVER YOUR REQUIREMENTS, the Elliott line of turbines can provide the simple, reliable answer. From the smallest type JR up to the largest multistage, Elliott mechanical drive turbines have the design, the construction and the flexibility to do the job right.

Contact your local Elliott field engineer or write Elliott Company, Jeannette, Pa. for information and descriptive bulletins.

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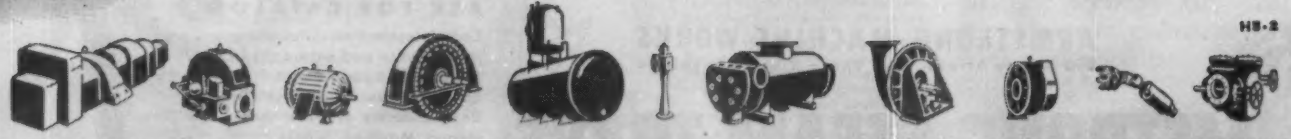
HB-2



TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

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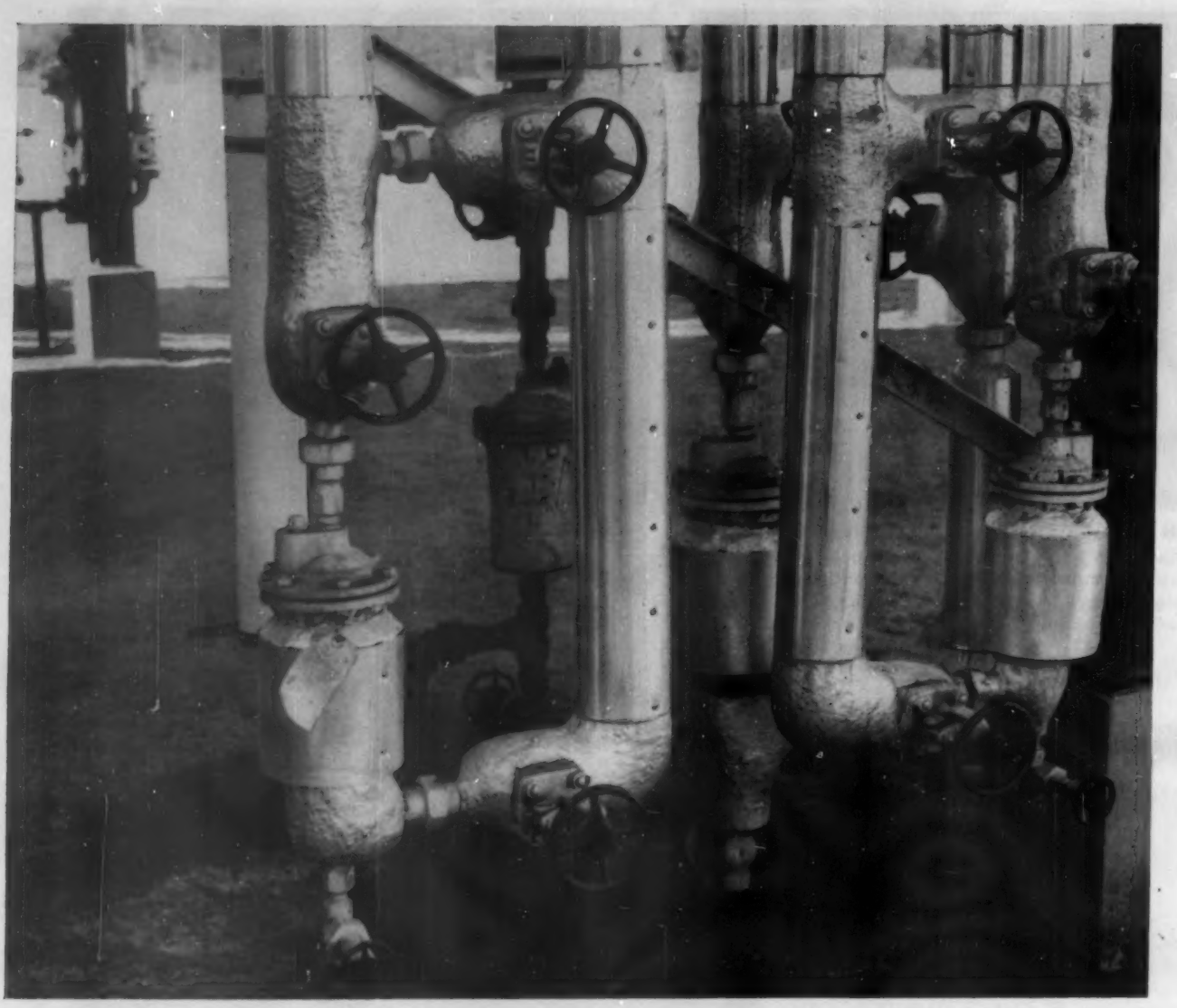

Picture of Low Cost Steam Trapping . . .

The Armstrong steam traps pictured above are in a field processing plant in Oklahoma. It's a nice installation—traps neatly installed in bypasses, lines well insulated, blowdown valve below each trap. Obviously, no corners have been cut to save nickels. Then, what do we mean by "picture of *low cost* steam trapping." Simply this:

Low cost traps—the price tag doesn't read any lower, but, because of high capacity, you can usually select an Armstrong trap one size smaller than other makes.

Low cost installation — Armstrong offers a choice of either side inlet-side outlet or bottom inlet-top outlet traps in most sizes so that hook-ups can be made with a minimum of labor and fittings. All traps can be equipped with internal check valves, and the three smallest traps are available in integral strainer style. These optional built-in features mean lower installation costs.

Low cost maintenance—Armstrong traps last for long periods without repairs because the valves and seats are corrosion-resistant, file-hard chrome steel, ground and then lapped together; and all other working parts are corrosion-resistant stainless steel. Materials and workmanship are unconditionally guaranteed.

Low production costs—because Armstrong traps provide fast drainage and have large air handling capacity, they provide maximum output from steam heated units and give a bigger return on equipment investment. They save steam, too, through reduction of non-productive radiation losses and freedom from leakage.

For *low cost* trapping it pays to specify "traps shall be Armstrong."

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Complete selection, installation, maintenance and trap data in the useful 44-page Steam Trap Book. Call your local Armstrong Representative or write Armstrong Machine Works.

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ENGINEERS' PREVIEW

CLOUD-SEEDING experiments to increase winter snowfall in California have had some success, according to a recent report to the American Meteorological Society meeting at New York University.

More observations are needed, however, to determine finally whether man has learned how to make snow at will, said meteorologist Charles L. D'Ooge of the U. S. Naval Ordnance Test Station, Inyokern, China Lake, Calif.

In the three years before the experiments, the greatest snowfall occurred when the temperature dropped to 12 F. Since the experiments, he said, the region gets maximum snowfall at a higher temperature of 25 F as well. Since the temperature falls to 25 more often than to 12, the net effect is an increase in total snowfall.

Power companies with hydroelectric plants along streams and lakes in the Sierra Nevadas are attempting to increase winter snowfall there, Mr. D'Ooge said, because more melting snow will yield more power.

• • •

CONSOLIDATED EDISON CO. of New York has announced the purchase of eleven 138-kv outdoor compressed-air breakers from Westinghouse. They will have an interrupting capacity of 10,000,000 kva.

These are the first outdoor compressed-air breakers of this rating to be built for an electric utility by an American manufacturer. They will operate at air pressures of approximately 350 psi.

BECAUSE OF the increasing interest in higher operating temperatures and pressures for greater efficiency of chemical and metallurgical processes, the Alloy Casting Institute has reprinted a paper entitled Corrosion by Aqueous Solutions at Elevated Temperatures and Pressures, presented by Dr. F. H. Beck and Dr. M. G. Fontana, Ohio State University, at the Ninth Annual Conference of the National Association of Corrosion Engineers.

Dr. Beck and Dr. Fontana are investigating commonly used alloys of the 18-8 variety (CF-8 and CF-8M) and high nickel grades in a variety of corrodents. Modifications of these alloys will be studied to develop improved corrosion resistance and methods for inhibiting corrosive attack. The Beck-Fontana paper deals with preliminary results which suggest the possibility of utilizing minute amounts of inhibiting agents in chemical fluids.

• • •

AMERICAN SOCIETY OF HEATING and Air-Conditioning Engineers elected John E. Haines president at the 61st Annual Meeting held in Philadelphia, January 24–27. He is vice-president of Minneapolis-Honeywell Regulator Co., served the Society as first vice-president during the past year, and held the office of second vice-president in 1953.

• • •

TWO new determinations of the velocity of light have been made by National Bureau of Standard scientists. Although carried out independently by widely different methods, the two determinations give precise values that are in close agreement. They also provide confirmation for the higher values of electromagnetic wave velocity that have been consistently obtained by microwave measurements since World War II.

Velocity of electromagnetic waves has been a subject of investigation for many years. In the period pre-

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PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ceding World War II, the value 299,776 ± 4 kms per sec was generally accepted as an average of the findings of the various laboratories. However, since the war higher values have been obtained by most investigators, largely through measurement of the velocity of propagation of microwaves. Consideration of this more recent work has led to an average value[2] of 299,793 ±1 km per sec. The results obtained by the Bureau give 299,792 ±6 km per sec by the molecular constants method and 299,795.1 ±3.1 km per sec by the radio interferometer.

• • •

ELECTION OF D. C. Hormell, chief engineer of Pioneer Service & Engineering Co. of Chicago as vice-president and chief engineer has been announced by Fred C. Kellogg, president of the company. Mr. Hormell, who has been associated with the company for the past 25 years, is a mechanical engineering graduate of West Virginia University.

• • •

JUNIOR SCIENTISTS of today will be senior scientists of tomorrow. One organization that has fully recognized this for years is Westinghouse, which makes yearly awards to young high school students for outstanding achievements in science and technology. Another recent example to come to light is that of Central Scientific Co., which may provide another answer to industry's shortage of skilled technicians, scientists and engineers.

Central Scientific Company, one of the leading manufacturers of scientific instruments, is now distributing a number of educational hobby kits, designed by experts, to inspire children from 8 to 18 to develop scientific talents and acquaint them with many career opportunities. Because children learn by doing, these kits provide them with necessary materials and instruction to pursue various types of hobbies.

There is an electronics kit produced by RCA, with which a young person can build battery-operated radio transmitters and receivers, and perform other experiments in electronics. There is a medical training kit, produced by Bauer and Black, designed to show some of the basic facts about the human body and how to apply simple first aid measures in emergencies. A rock detective kit produced by Geological Institute of America contains basic tools and scientific information for the study of geology. American Optical Co. has provided an optical kit for the study of the basic principals of optics, and finally there is a weather kit produced by Taylor Instrument Companies, from which the young person can learn how weather instruments work and how to read the signs that determine the weather.

These kits range in price from approximately $15.00 to $30.00, and if you are interested in getting any of them for your own children or as gifts, the Engineers' Preview Editor will gladly tell you how. However, please DO NOT order them from us, and DO NOT send us any money. We're not selling them.

TWO PLANTS on the American Gas and Electric System — Kanawha River and Tanners Creek — were the most efficient steam-electric generating stations in the nation in 1953, according to the annual report of the Federal Power Commission.

Kanawha River Plant at Glasgow, W. Va., owned by Applachian Electric Power Co., an AGE subsidiary, topped the nation's plants with a 9,170 Btu per kwh heat rate. Tanners Creek Plant at Lawrenceburg, Ind., owned by another AGE subsidiary, Indiana & Michigan Electric Co., was rated second with a heat rate of 9,329 Btu per kwh.

According to past annual reports of the FPC, the American Gas and Electric System has had the nation's most efficient plant every year since 1950.

LETTERS TO THE EDITORS

More on the Power Plant Trouble Shooter

IN REFERENCE to the article on page 76, March issue, when taking over an old system, particularly one that has operated 4 P.M. to 8 A.M. in the wintertime and 5 P.M. to 7 A.M. in the summertime, many conditions are discovered that attest to the remarkable ruggedness of electrical equipment. One system, which for years had operated at 1150 v, 125 cycles, had transformers only partly filled with oil, and another had nothing but cobwebs in it. So far as known, no fatalities had resulted and grounding of secondaries was unknown.

Most of the transformers were fused with sizeable pieces of copper wire in porcelain plug-type cutouts. There was no fuse blowing, of course, although at times there were interruptions due to the "falling out" of the fuse plug which depended merely on the "spring" of the contacts to hold it in place. In the case of joint use with the telephone company, a telephone lineman was struck on the head by a falling plug and made unconscious, held only by his body belt from falling to the ground.

The addition of a copper cent to plug fuses, not uncommon even today, made fuse blowing at the house service fuse for branch circuits an impossibility.

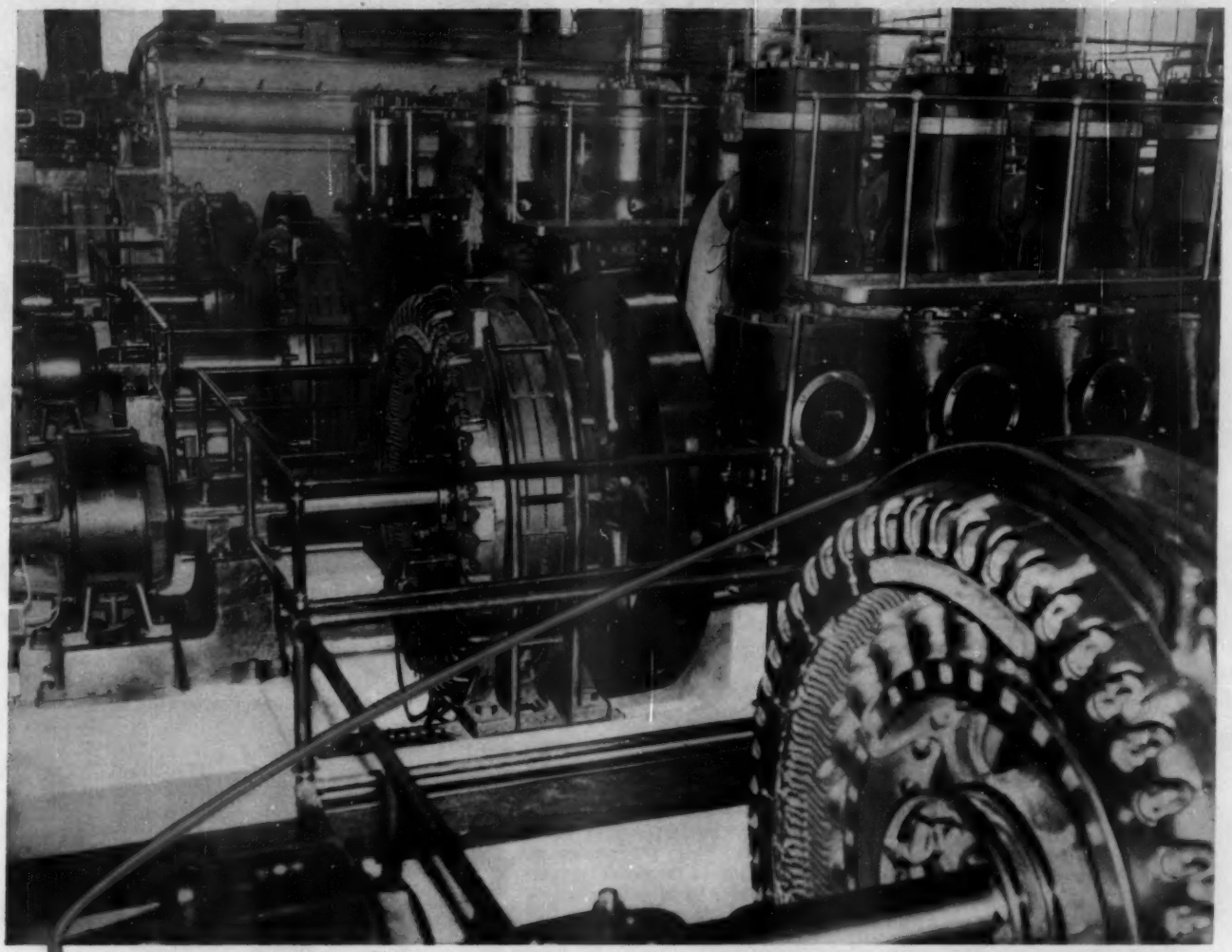
Where the system had once been 2 phase 4 wire, later changed to 3 phase, many 2 phase motors still remained in operation, and the transformers used were 2200/220-v units without Scott tap, so the motors operated with unbalanced voltages between two sets of the lines.

Concerning fuses, a most troublesome fault was to find 440-v fuses mounted on slate bases that were not free from metallic veins, with the result that overheating of the base resulted and even shocks were experienced with fuses removed, due merely to the leakage.

Three-pole knife switches operating at 440 v often had yokes made of impregnated compressed paper. During the process these had been bleached and not sufficiently cleansed before impregnation, so the yokes heated and even burned up, causing short circuits.

A rather amusing incident occurred when a report was made to an insulator manufacturer that all the insulators furnished were defective. Inspection indicated that the system designed for 33 kv operation was being temporarily operated at 13.2 kv. The operator made tests using a so called "buzz stick" where the test gap was set for 33 kv so there was no sound of an arc-over on the test gap and no sound in the detector telephone. It required some diplomacy on the part of the insulator salesman to tell the operator he was wrong in his test. — *C. O. von Dannenberg, Brooklyn 3, N. Y.*

Resists Wear!



Switch now to Sinclair GASCON® Oils for top anti-wear lubrication and longer engine life in your diesel engines.

Actual performance results prove that the superior GASCON Oils eliminate stuck piston rings, reduce carbon deposits on vital engine parts, cut cylinder wear to a minimum . . . and improve the ratio of KW-HRS. per GALLON of Lubricating Oil.

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HERE'S WHAT THEY TELL US

THE STAGGERING RAPIDITY of changes occurring in atomic reactor development has been the subject of considerable correspondence between our editor and a correspondent abroad. In a recent letter, Editor Kramer wrote:

> The Shippingport Station undoubtedly was out of date before construction even started. However, it is a start and I understand that before the Station is completed it may be more economical in point of power per pound of fuel than the designers originally expected. As I understand it, the rate of breeding has been stepped up and that, of course, would result in a great plutonium production.
>
> The carbon dioxide cooled reactors at Calder Hall probably will not be very economical either, but if they can produce power for seven tenths of a cent per kilowatt hour, as I have recently read, they are coming pretty close to competitive power in England. It will be very interesting to see how the performance of this Station turns out.
>
> Over here, as I pointed out in *Atomics*, the most important development is the fact that the Babcock & Wilcox Company has taken over the study of the liquid metal fuel reactor system developed at Brookhaven Laboratories. In my opinion, this offers the most promising scheme for producing competitive power, and I am quite certain that a start on this type of plan will be made over here before very long.
>
> There is no question but that American manufacturers, particularly the boiler and electrical manufacturers, are very much interested in the development of atomic power and all of them are working at it. I think that we will begin to see some tangible results in a year or two.

England's Calder Hall is a 50,000 kilowatt plant and really will be the first actual atomic power plant in the world.

RAYMOND C. KELLY, Executive Manager, Cooling Tower Institute, queried:

> Would there be any chance that your morgue files might contain as many as 12 or 15 copies of the article entitled "Induced Draft Cooling Tower Test Performance" by E. S. Gray which was published in the February *1944* issue of POWER PLANT ENGINEERING magazine? If your files do not contain copies of this article would it be with your permission that we made photocopy prints of it for distribution to our Cooling Tower Institute technical subcommittee which is now reviewing the subject of cooling tower test performance?

Yes, indeed! It is always gratifying to extend permission for this dissemination of technology.

IT WAS GOOD to know also that E. T. Lauriat of Ohio had an interest in our February '55 Engineers' Preview page. We don't blame him one bit for questioning that word *ocosity*. It can't be found in the dictionary or anywhere else, but because the entire quotation in any case was mostly foolery and nonsense, we left it in. It might have been *jocosity*.

The whole thing is a good example of what a famous writer, Dr. Johnson, once called "sesquipedalian verbiage." Anyway, it's fun to read.

R. A. BUDENHOLZER, director, American Power Conference, wrote:

> Thank you for the excellent coverage given to the American Power Conference in your March issue. The manner in which it was written is interesting, and I think it did a lot to help the reader get a clear picture of the scope of material to be covered in each field.

A NOTE from D. K. Reece, Dowell Incorporated, said:

> You may be able to help us solve a problem. . . . We need a flow diagram showing the operations of a power plant from the beginning to the end. What we are looking for is something on the pictorial side and not a straight technical flow sheet.
>
> We need this drawing for use by our field engineers. If you have anything that you think might be suitable, we would certainly like to have 250 copies.

Unfortunately we did not have any such sheets in quantity. But assuming that Mr. Reece was thinking of steam power plants, our executive editor searched his own personal engineering file, which we discovered to be an excellent source of pictorial representations. Mr. Reece thought so too. Within a few days he wrote Chester Earle:

> We certainly appreciated your cooperation in lending us these drawings. They were just what we needed.

REQUESTING PERMISSION to reprint in *Byjac News* the article entitled The Canned Pump, October '54 issue, page 89, W. N. Beadle, Byron-Jackson Co., noted:

> This house organ is distributed to our own BJ employees — at no cost whatever. That is, there is no commercial angle in the publication.
>
> You will appreciate that we are proud of what we have been able to do for the U. S. Atomic Energy Commission, as outlined in your October story.
>
> It might be of interest to you to know that we also supplied some special pumps for operation in the world's first atomic-powered submarine — the *Nautilus*.

We were much pleased to see the article reprinted in *Byjac News*.

VERY PLEASANT WORDS came to us from D. T. Burton, resident engineer, Machinery Division, Mutual Boiler and Machinery Insurance Co.:

> POWER ENGINEERING is excellently compiled; the articles are clear, concise and written in an interesting manner.
>
> My eldest son in high school also reads the magazine thoroughly, especially the "POWER ENGINEERING Handbook" — results: highest marks in science and engineering subjects.

WE JUST LEARNED from the University of Wisconsin that the Power System Protection Institute, originally planned for May 9, 10, 11, had to be postponed until June 1, 2, and 3. The Institute will cover the fields of Industrial Power Systems, Distribution Systems, and Relaying.

The forum last year was so successful that this year there will be two: one on Industrial and Distribution Systems, and the other on Relaying.

"I guess more of us would win safety awards for no accidents if all we did was pack felt washers in cellophane sacks."

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A sailboat has no choice—it must depend upon an undependable wind for locomotion. Fortunately, you have a choice in fuels for your firing system. Select the fuel known for *complete* dependability—Bituminous coal! It's the one fuel which gives you:

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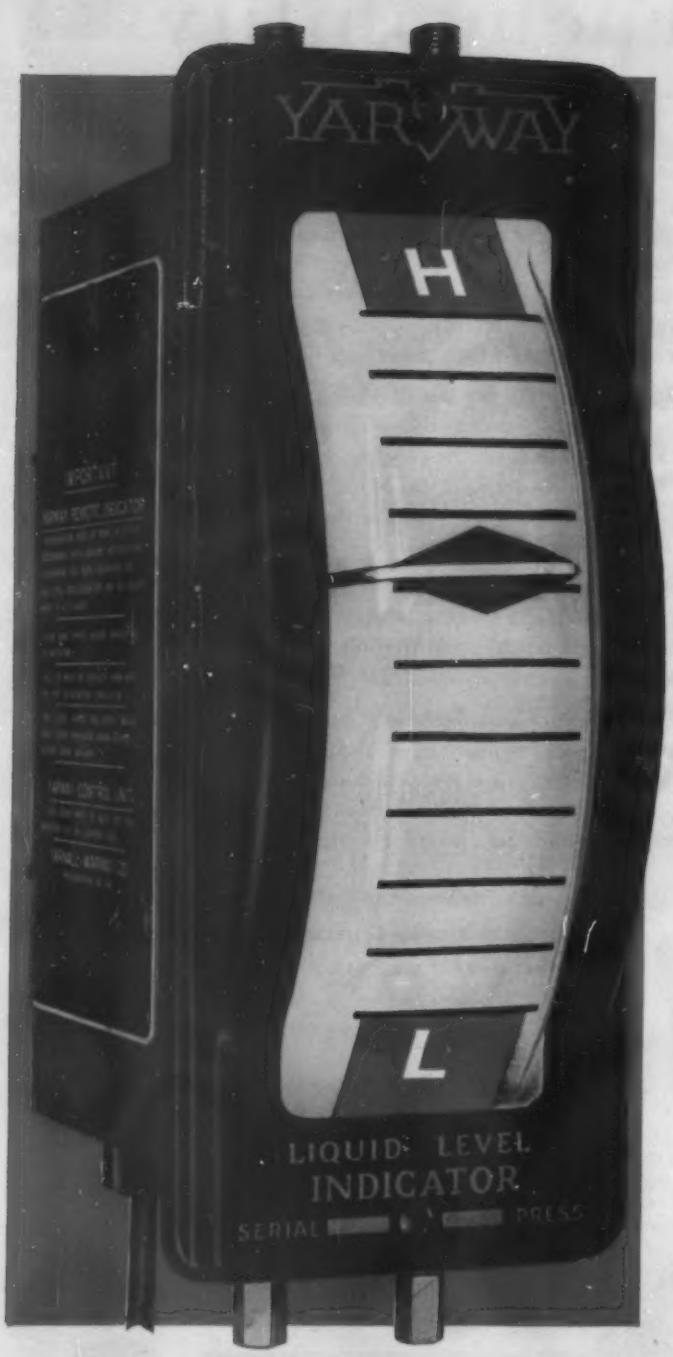

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Instant . . . accurate . . . brilliant . . . continuous readings of boiler water level are seen on the panel or wherever you wish in your plant. You know the readings are right because they are controlled by the boiler water itself . . . by the pressure differential between a constant head of water and the varying head in the boiler drum. *Indicating mechanism is never under pressure.*

Yarway Indicators may be equipped with a Yarway Control Unit that operates Remote Hi-Lo-Alarm signal lights or horns. For a 24-hour record of boiler water levels, use the Yarway Hi-Lo-Graph Recorder.

On the boiler drum itself you'll want Yarway Water Gages . . . and these "bright as a star" gage readings can now be televised with a Yarway—RCA Television chain.

From drum to panel and at all remote locations, Yarway equipment gives you the safest boiler protection you can buy . . . proved beyond doubt in thousands of power plants.

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Described in Yarway Bulletin WG-1824.

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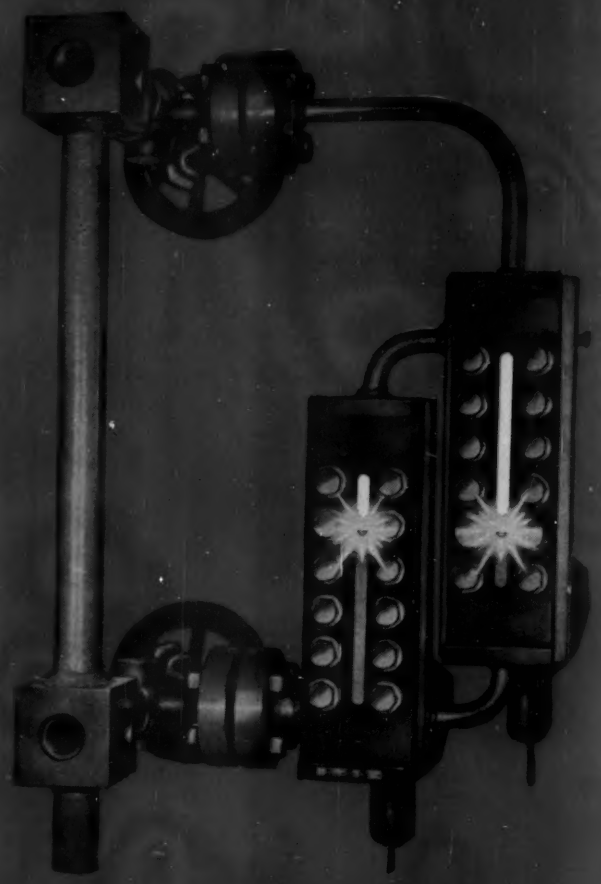
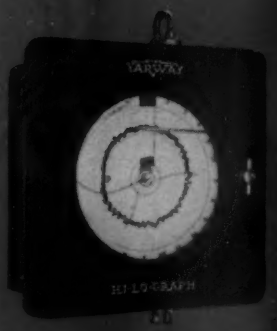


YARWAY WATER GAGES

Flat glass, high pressure type shown, features new separated-design insert and Type "M" illumination that causes water level meniscus to "shine like a star". Described in Yarway Bulletin WG-1812.

YARWAY REMOTE SIGNAL ALARMS

Lights on horns, operated by Control Unit on Yarway Indicator, give instant warning of any serious deviation from normal water level. Can be located anywhere in plant. Described in Yarway Bulletin WG-1824.



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Gives a continuous 24-hour record of liquid levels. Actuating mechanism is same as in Yarway Indicator. Used both for indicating and recording. Described in Yarway Bulletin WG-1830.

YARWAY TELEVISION

Simplified system consists of compact camera and panel-mounted monitor. Clear, bright image of water level gage anywhere in the plant.
Described in Yarway Bulletin WG-1813.

steam plant equipment

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
LIQUID LEVEL INDICATORS
EXPANSION JOINTS
STEAM TRAPS
STRAINERS
SPRAY NOZZLES
DIGESTER VALVES

For more data circle 505 on Post Card

CP&L's new plant at Wilmington, N.C., has been named the *Louis V. Sutton Steam Electric Generating Plant* in honor of the company's president. The first mammoth boiler of this outdoor-type unit towers 17 stories high, and produces steam up to 1,000° F with 1,600 lbs. pressure per sq. in. CP&L's system includes three other large fuel-burning plants, plus three large hydroelectric plants.

For new #1 unit of Louis V. Sutton Plant, CP&L installed these two American Blower Sirocco Induced Draft Fans. Each is rated @ 225,000 cfm @ 585 rpm @ 291° F @ 16" sp. If *your* plans call for mechanical draft equipment, fly ash precipitators, heavy-duty steam coils, or fluid drives for boiler feed pump and fan control — contact your American Blower Branch Office, today.

Serving home and industry: **AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS &**

Carolina Power & Light Co. ups capability to 922,000 kw with new outdoor unit

Carolina Power & Light Company's new steam plant reflects design progress, uses American Blower Draft Fans

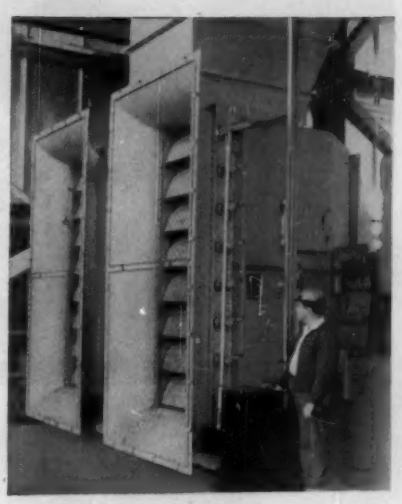
The new Louis V. Sutton Steam Electric Generating Plant at Wilmington, N.C., is the Carolina Power & Light Company's first plant of outdoor-type construction to be built entirely above ground. No. 1 unit, which went into operation July 1954, adds 105,000 kw to CP&L's generating network, boosting total capability to 922,000 kw!

Laid out for a maximum of six generating units, this new plant will be the largest in the company's vast system . . . a system that serves over 2,000,000 people in 30,000 square miles of the Carolinas. Its outdoor design saves on construction costs and time, and reflects CP&L's many years of progress: continually expanding and increasing service to customers.

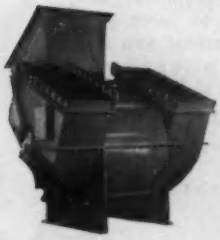
Along with cost-cutting outdoor construction, CP&L chose efficient and dependable equipment, including American Blower Forced and Induced Draft Fans.

Across our nation, progressive, investor-owned utilities prefer American Blower equipment because it performs at peak efficiency, indoors or out, with minimum maintenance. They know you can rely on American Blower's Forced and Induced Draft Fans, Fly Ash Collectors, Gyrol Fluid Drives for boiler feed pump and fan control, and Heavy-duty Steam Coils.

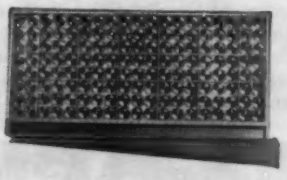
May we assist in *your* progressive program? Give your nearest American Blower Branch Office a call, or write us direct.



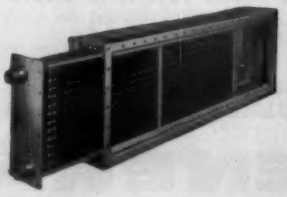
This is one of two American Blower Sirocco Forced Draft Fans installed on #1 unit at CP&L's Louis V. Sutton plant. It is rated @ 140,000 cfm @ 585 rpm @ 100° F @ 14.4" sp.



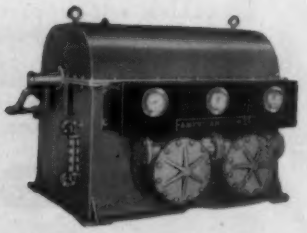
Mechanical Draft Fans for induced and forced draft



Collectors and precipitators for dust and fly ash control



Heavy-duty steam coils for high pressure duty



Gyrol Fluid Drives for boiler feed pump and fan control

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

For more data circle 506 on Post Card

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

When you need Rubber and Plastic Power and Control Cables . . . look to General Cable . . . for every type, for every use . . . for fast deliveries . . . for UNMATCHED QUALITY! These General Cable products have earned an enviable reputation among users for transmission, distribution and control . . . for direct earth burial . . . for duct and conduit . . . for submarine use . . . and for self-supporting aerial applications.

As the biggest producer, General Cable makes the widest range of types. To mention a few: low and high voltage power cables, signal control and alarm cables, self-supporting aerial cables, interlock armored bus drop cable.

Constructions consist of copper and aluminum conductors. Insulations: GENCASEAL (Thermoplastic Vinyl), polyethylene, THERMAX W (moisture and heat resistant), AQUASEAL (heat and moisture resistant — low SIC), GENCORONE (ozone-resistant oil base), BUTARONE (ozone-resistant butyl base).

Outer coverings include rubber, neoprene, GENCASEAL, lead, reinforced neoprene over lead, and textiles (cotton, glass, asbestos, sisal, jute, rayon).

Armor finishes include steel, bronze, aluminum interlock; flat steel, and galvanized wire armor.

These popular and versatile products are made to meet *every* operating condition. Where standard types are not suitable for your particular use, special constructions will be made to meet your exact needs. Get the complete facts before you buy. Let our engineers help to solve your wire and cable problems. And, remember, that General Cable is the *only* manufacturer who can supply *all* your wire and cable needs!

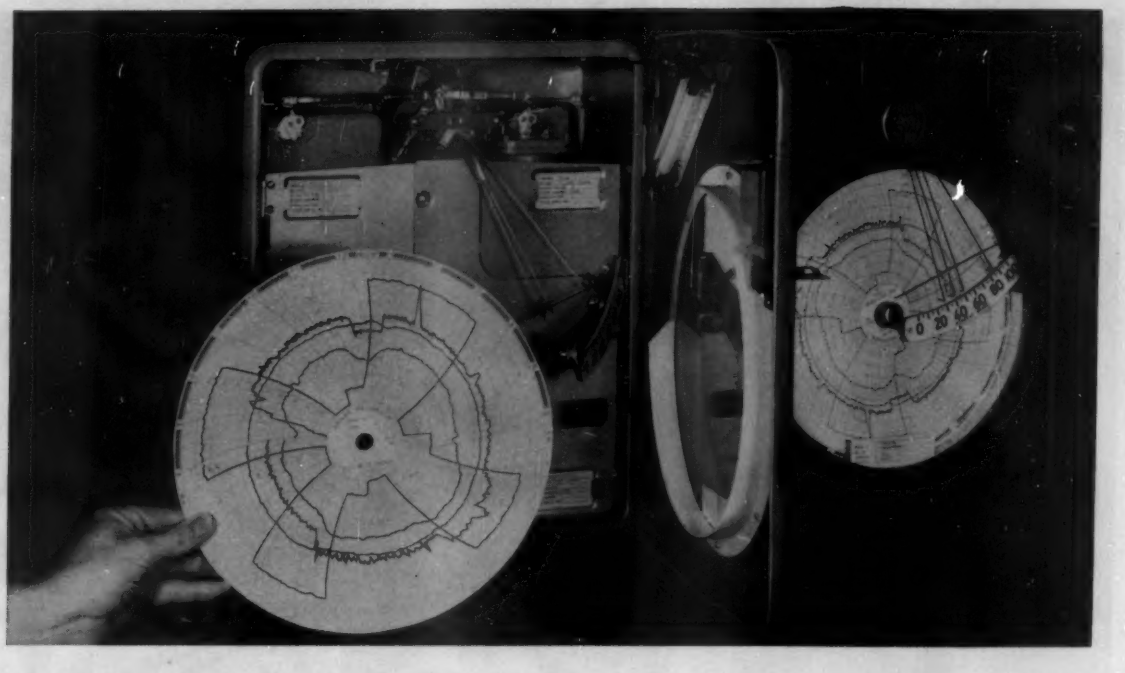
GENERAL CABLE
CORPORATION

BARE, WEATHERPROOF, INSULATED WIRES and CABLES FOR EVERY ELECTRICAL PURPOSE

GENERAL CABLE CORPORATION
Executive Offices: 420 Lexington Ave., New York 17, N. Y.

SALES OFFICES: Atlanta • Baltimore • Boston • Buffalo Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit Erie (Pa.) • Greensboro (N. C.) • Houston • Indianapolis Kansas City • Lincoln (Neb.) • Los Angeles • Memphis Milwaukee • Minneapolis • New Haven • Newark (N. J.) New York • Philadelphia • Pittsburgh • Portland (Ore.) Richmond (Va.) • Rochester (N. Y.) • Rome (N. Y.) St. Louis • San Francisco • Seattle • Springfield (Ill.) Syracuse • Tampa • Tulsa • Washington, D. C.

For more data circle 507 on Post Card



Faithfully yours –

Clear, Continuous Records without Poisoning . . . on the New Bailey Recorder

★ Faithful chart records of measured variables are the key to a meaningful, dependable analysis of operating trends and conditions. Money spent for more accurate metering, for faster response, is money down the drain—*unless* it's matched with chart records that are equally accurate.

That's why these features of the new Bailey Recorder are important to you:

1. Bailey's exclusive sealed capillary-action inking system maintains continuous flow to the pen tip, and traces sharp, opaque, quick-drying records. "Poisoning" of intersecting records is practically eliminated; no blots or smears during operation or chart changing.

2. Pens are mounted on concentric centers, trace on parallel time arcs only 42/1000" apart. This simplifies analysis of two or more records.

3. Interchangeable plug-in receiver units permit practically limitless record-grouping combinations.

Write for Product Specification E12-5 and actual chart sample. P22-1

ONLY BAILEY OFFERS ALL THESE ADVANTAGES IN A SINGLE RECORDER

- Pre-calibrated plug-in receiver units
- Up to four pneumatic or electronic receivers —or two receivers and two integrators
- Any four variables on one chart—easily read and interpreted
- A full year's ink supply at one loading
- Faster shipment—from stock
- Minimum inventory of parts
- Minimum instrument investment for process cycle expansion or alteration

BAILEY
METER COMPANY
1040 IVANHOE ROAD
CLEVELAND 10, OHIO
Controls for Power and Process

BAILEY METERS
Controls for
TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW · LEVEL
RATIO · DENSITY

For more data circle 508 on Post Card

B&W Integral-Furnace Boiler with its control panel at Mill No. 3 boiler plant of Highland Park Manufacturing Company. Presently coal-fired with Detroit RotoStoker, the boiler is designed for future oil and gas firing. B. O. Vannort Engineers, Inc., are the consulting engineers for this installation.

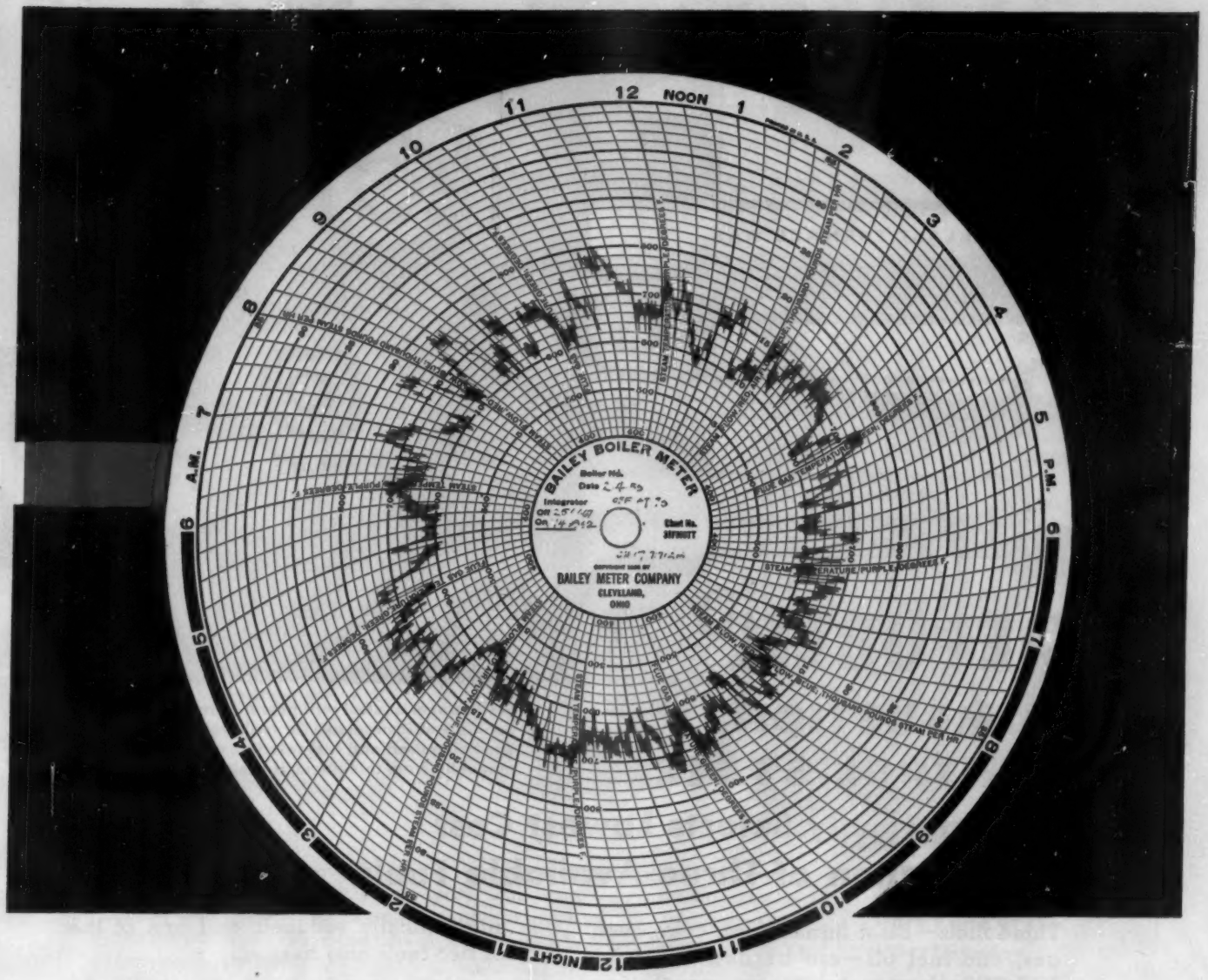
HIGHLAND PARK MANUFACTURING COMPANY

Saves 20% on

with a B&W Integral-Furnace Boiler

When a study of boiler plant costs confirmed that boiler and auxiliary facilities at Highland Park Manufacturing Company's Mill No. 3, were inadequate and costly, a B&W Integral-Furnace Boiler was installed to replace one of the two old steam units in the plant. Other charges and replacements, including steam piping and ducts and a coal-handling system, were made at the same time. And from the day the new equipment went into operation the boiler plant started to pay for itself. An indication of actual savings is shown by the 706-ton annual reduction in fuel consumption—a full 20 per cent saving and in itself strong justification for the plant's modernization.

The new B&W Boiler provides 25,000 lb of steam per hr, and 27,500 lb per hr to meet peak loads. Designed for a pressure of 250 psi, the boiler is currently being operated at about 150 psi. Coal-fired, it has provision for future installation of oil- and gas-firing equipment without disturbing the stokers, to derive full benefit from fuel price fluctuations. Also, this new unit assures a constant and reliable steam supply with quick response to the wide load swings common in the course of normal operation. It is equipped with complete controls, an alarm system and other protective devices to minimize manual operation and supervision. In addition to fuel savings, the Company reports overall



Fuel Alone

boiler efficiency consistently high, the plant much cleaner than before, and maintenance costs reduced substantially.

Highland Park Manufacturing Company and many other industrial plants in various categories have found B&W Integral-Furnace Boilers ideally suited to their steam requirements. If you are considering steam plant modernization or expansion to improve efficiency, get full details concerning B&W Integral-Furnace Boilers, available for steam requirements from 2900 to 350,000 lb per hr. Write to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

COST-SAVING FEATURES

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

BOILER DIVISION

G-707

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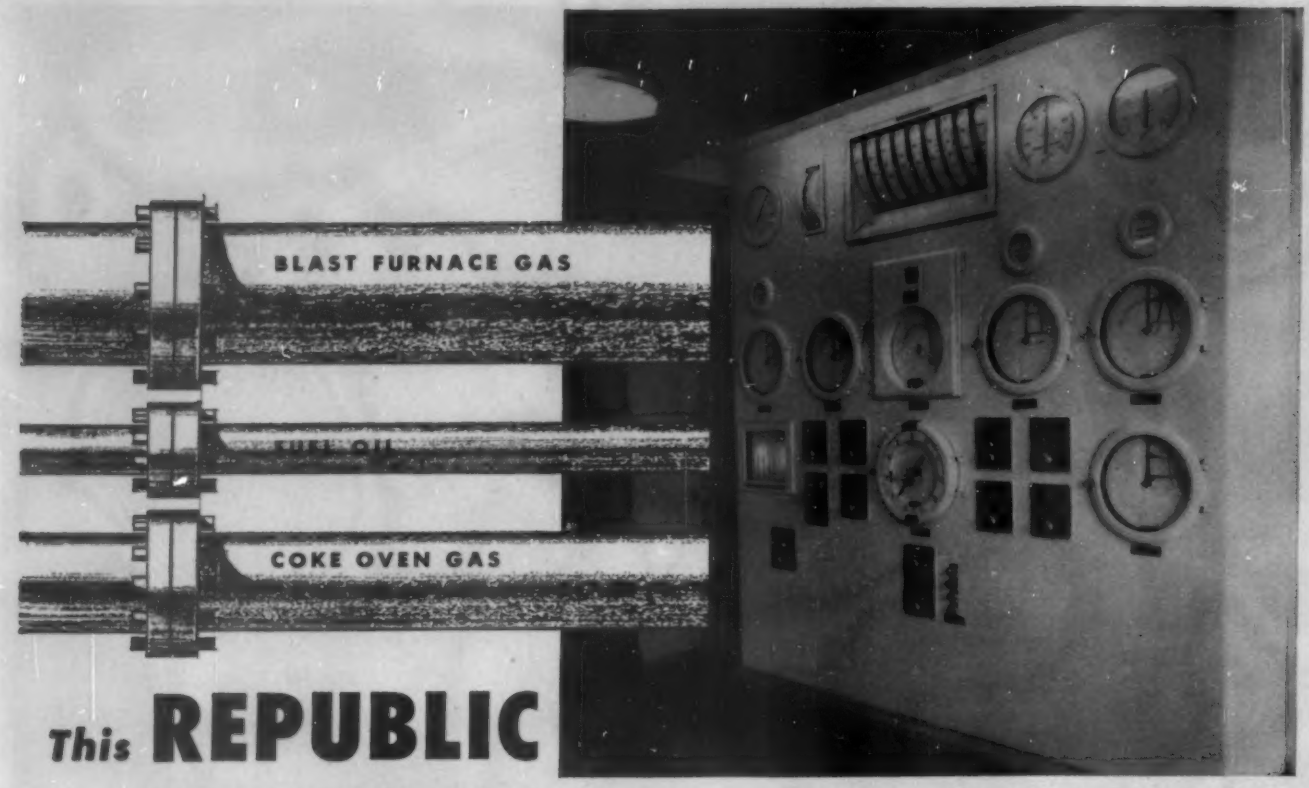

Boiler panel at steel mill power plant includes sub-panels and instruments for multi-fuel firing system. The boiler draft and fuel selection may be controlled manually from this panel, if desired.

This REPUBLIC COMBUSTION CONTROL SYSTEM

Automatically Selects Lowest Cost Combination of Three Available Fuels

Three fuels—blast furnace gas, coke oven gas, and fuel oil—are burned by three 125,000 lb. per hr. steam generating boilers at a large midwestern steel plant.

In addition to maintaining the proper fuel-air ratio and holding steam pressure constant at all loads, a Republic Control System automatically makes fuel selections according to the amount of by-product blast furnace gas available. At times when this low cost gas is plentiful, it is used as the primary fuel. The other two fuels are used only for make-up when available blast furnace gas cannot meet all of the fuel demand. If the blast furnace gas pressure falls below a predetermined minimum, however, flow is automatically reduced and one of the other two fuels also burned.

This dual purpose Combustion Control System cuts fuel costs two ways:

(1) Because of efficient combustion, less fuel is used for a given steam output.

(2) As much lowest cost fuel is used as possible.

Control Systems such as this one further illustrate how Republic engineers can design combustion controls that make the most of fuels available. Very likely, Republic can show *you* ways to get more power at less cost — automatically.

REPUBLIC AUTOMATIC COMBUSTION CONTROLS

★ For all types and sizes of boilers ★ For all types of fuel
★ For all types of firing
★ For all arrangements of draft ★ For all load conditions

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

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To meet the stepped-up needs of industry...
for more power—better performance—longer life...

ALLIS-CHALMERS PRESENTS THE BIGGEST, MOST POWERFUL CRAWLER IN PRODUCTION ...ANYWHERE!

ALLIS-CHALMERS

HD-21

204 net engine hp
44,000 lb

New standards of output The HD-21 introduces the new Allis-Chalmers engine and a great new power team. Together, they provide extra speed with any load, extra pulling power at any speed . . . wider speed ranges and more range overlap. And with its advanced design torque converter (*the result of 15 years of leadership by Allis-Chalmers*) the HD-21 puts its power to work with less shifting than ever before possible . . . to help you reach a new high in efficient, profitable production!

New standards of durability From the new Allis-Chalmers diesel with "follow-through" combustion to new, heavier Tru-Dimension track, the HD-21 is built to take today's big loads in stride, and come back for more. Here are just a few more of the long-life features you can't get from anyone but Allis-Chalmers . . . at any price: all-steel Box-A main frame, straddle-mounted final drive gears, 1,000-hour truck wheel lubrication, oil-enclosed track release mechanism.

New low cost per unit of work The HD-21 offers 20 percent greater over-all performance . . . provides a new measure of tractor value. Add the *planned* approach to service offered by Allis-Chalmers dealers, and it's the ideal team for men tackling today's *big* jobs.

Here's one of the HD-21's many new features—

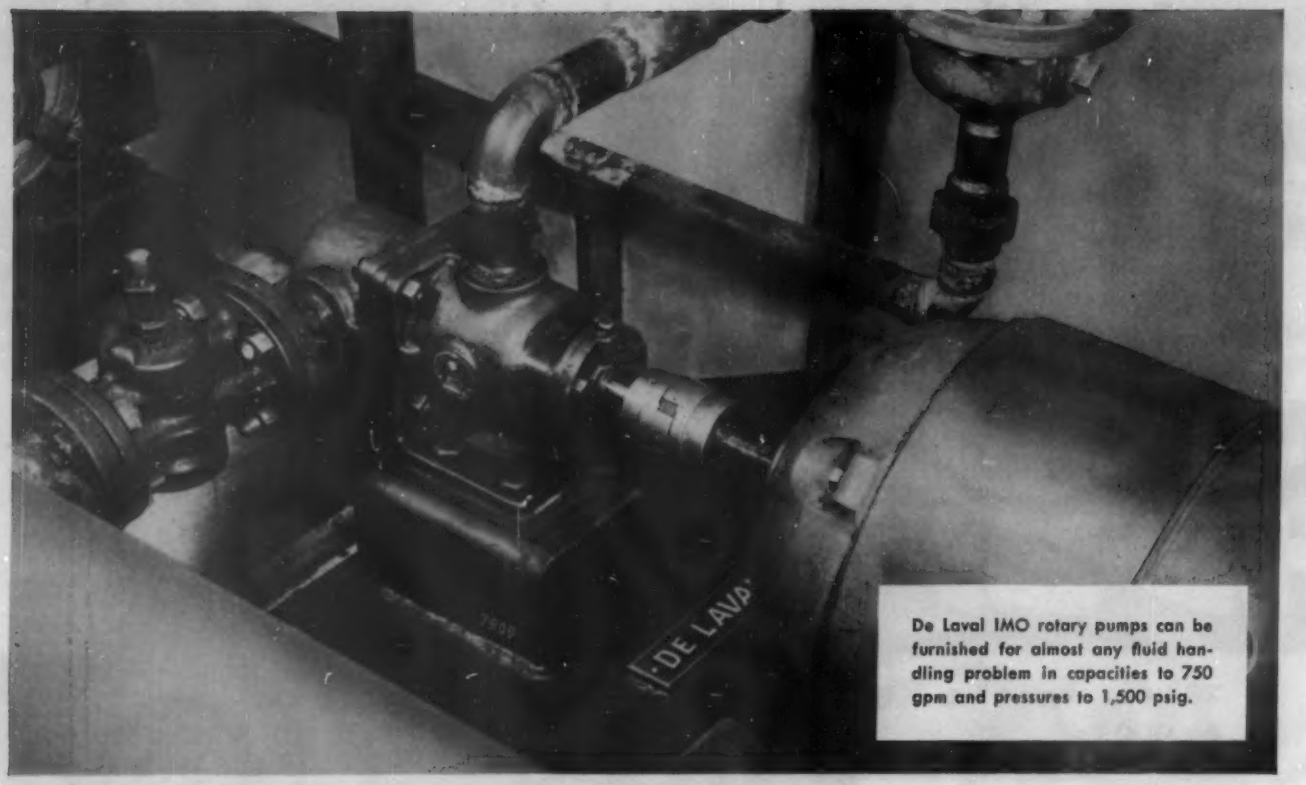
New Allis-Chalmers engine—
Brings you top performance, extra-long life through a new kind of "*follow through*" combustion. Here's why—

The key explosion occurs in the energy cell as shown, unleashing a blast that sets up cyclone turbulence. Result—no damaging peak pressures . . . instead, higher average working pressures and better leverage on the crankshaft. *Be sure to ask your Allis-Chalmers dealer for the visual story revealing the full advantages of this new engine.*

Nowhere can you match the HD-21 in the amount of work it will do!

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.



De Laval IMO rotary pumps can be furnished for almost any fluid handling problem in capacities to 750 gpm and pressures to 1,500 psig.

What to Look for in a Rotary Screw Type Pump

By W. J. MONCON, *Assistant Chief Engineer*
De Laval Steam Turbine Company

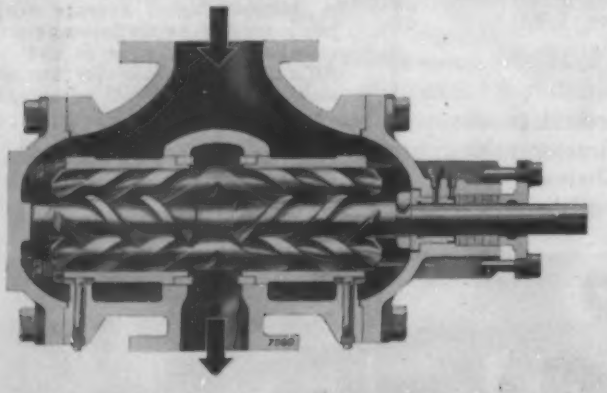
A sound knowledge of design, and how it affects performance, is the best insurance a buyer can have that he will get the pump he needs. This brief analysis of the IMO, a rotary three-screw pump manufactured by the De Laval Steam Turbine Company, will give you some of the necessary facts.

What qualities should you look for in a rotary type pump? It must, of course, meet specified capacities and pressures. But, it must also be efficient, operate quietly, stay on the job.

The axial flow of a screw type pump, and the resulting low inlet losses for any given pump speed, are important benefits that should be considered in making pump selections. The absence of timing gears and other mechanical features of construction also enable the De Laval IMO pump to operate at direct-connected motor and turbine speeds . . . to handle viscous liquids and high suction lifts.

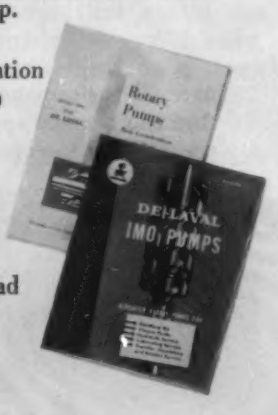
One of the most important features of the IMO pump is the hydraulic turning of the idler or sealing rotors. The central or power rotor is the pumping element; the liquid pumped turns the sealing rotors.

A screw type pump is well suited for applications where pulsation-free flow is desirable. The axial flow of the liquid without trapping and the unique thread form which keeps closures fluid-tight contribute to quiet operation of the IMO pump.



De Laval IMO Series A322A, a positive displacement, rotary screw type pump, can handle capacities to 750 gpm and pressures to 150 psig.

Catalog LS gives useful application and specification data on the IMO pump. An article titled, *Rotary Pumps, Basic Considerations in Their Application,* contains a description of rotary pumps in general. For these publications, write on your company letterhead to De Laval Steam Turbine Company, 816 Nottingham Way, Trenton 2, New Jersey. DL-301



Production goes on in the plant while

GUSTIN gb BACON SNAP*ON goes on the pipe....

This new and better way to insulate pipe saves valuable production time. Maintenance work or new installations can be completed faster. The photograph shows how a large manufacturer took full advantage of the one piece sections that were snapped on the overhead piping quickly, while work went on without fuss or muss in the plant below.

Ease of installation is just one reason why you should use Snap*On. The thermal efficiency of this new covering is the highest found in any pipe insulation, and because it is made of fine glass fibers it is tough and resilient. There is no breakage and virtually no mess to clean up when the job is done. It does not shrink, so the costly, time consuming job of pointing up opened joints is eliminated.

Your company is in the best of company when you use Snap*On, for a list of Snap*On users reads like "Who's Who in Industry". So don't put it off—put Snap*On on the very next time you insulate chilled or heated piping where temperatures do not exceed 350° F. The first step is to write for samples and our new brochure that contains complete technical data. Write today.

GUSTIN-BACON

Manufacturing Company

Thermal and acoustical glass fiber insulations
Pipe couplings and fittings • Railroad gaskets and supplies

250 W. 10th STREET KANSAS CITY, MISSOURI

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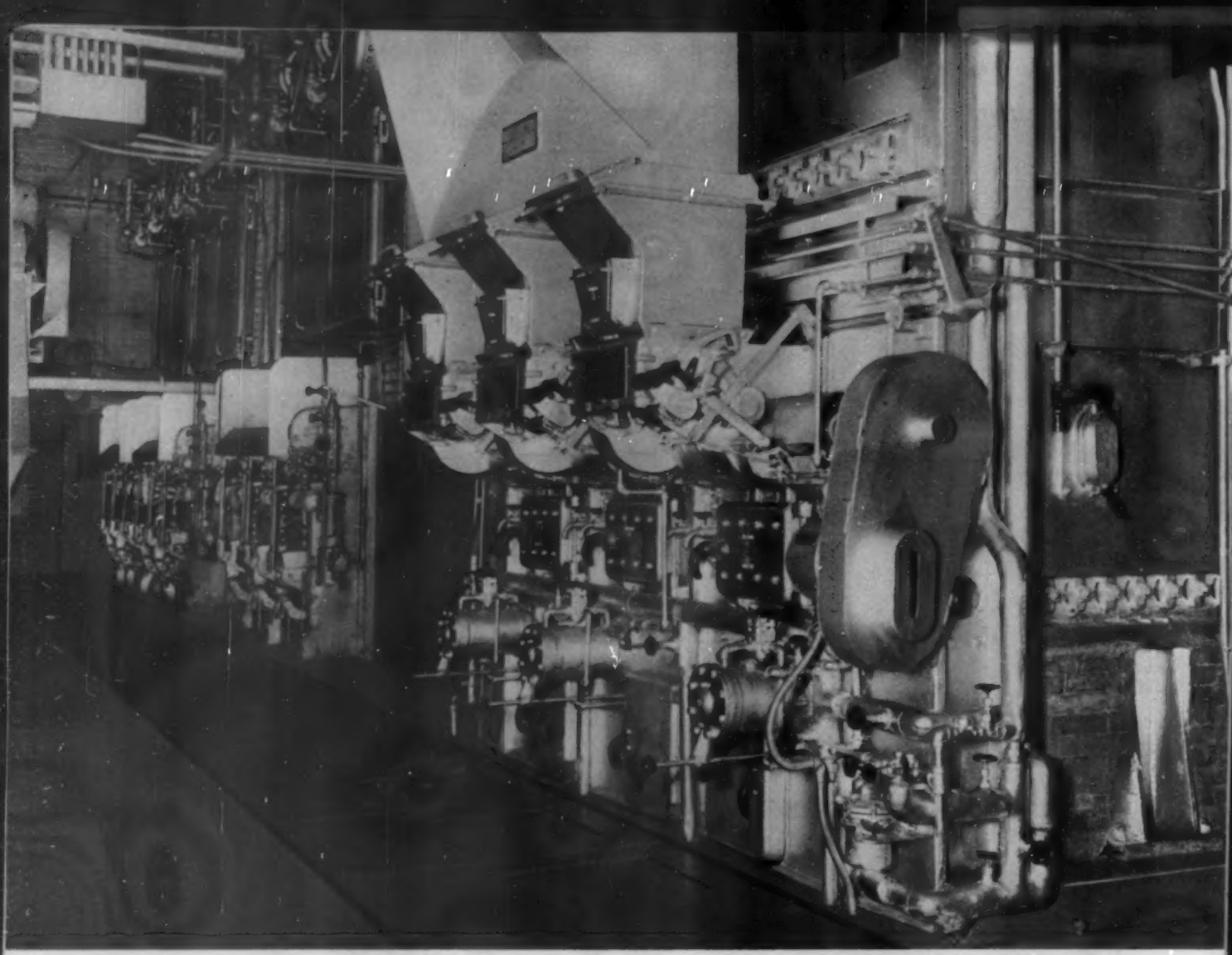


For efficiency and economy of operation, Liggett & Myers burns coal the modern way

In 1952, the steam demand of the Liggett & Myers Tobacco Co., Richmond, Va., had developed to the point where additional capacity was needed. The firm of Lockwood Greene Engineers, Inc., retained by Liggett & Myers to study the situation, recommended installing modern, automatic coal burning equipment to operate in conjunction with the original boilers. The equipment was installed.

The results have been extremely gratifying. The boiler plant now maintains constant pressure under high steam demand, the steam coal rate has increased 4.1 and there have been no operating difficulties. In addition, other benefits include reduction of labor, satisfactory air pollution control and improved performance records.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars every year.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can result in a virtually labor-free plant.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

For more data circle 514 on Post Card

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

Preferred for Precision and Performance

FIG. 19084—900-Pound Steel Pressure Seal Non-Return Globe Valve, Gear Operated.

Powell Valves are the choice of engineers because they know every valve is precision made, meeting every specification—every time.

And there are other good reasons why engineers prefer Powell Valves—because Powell Valves are dependable . . . economical . . . and Powell has the COMPLETE quality line of valves.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have.

The Wm. Powell Company
Cincinnati 22, Ohio... 109th year

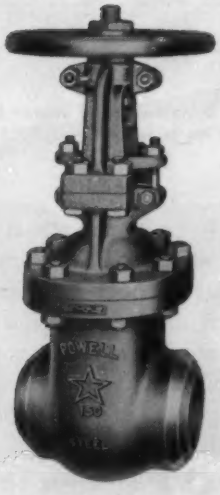


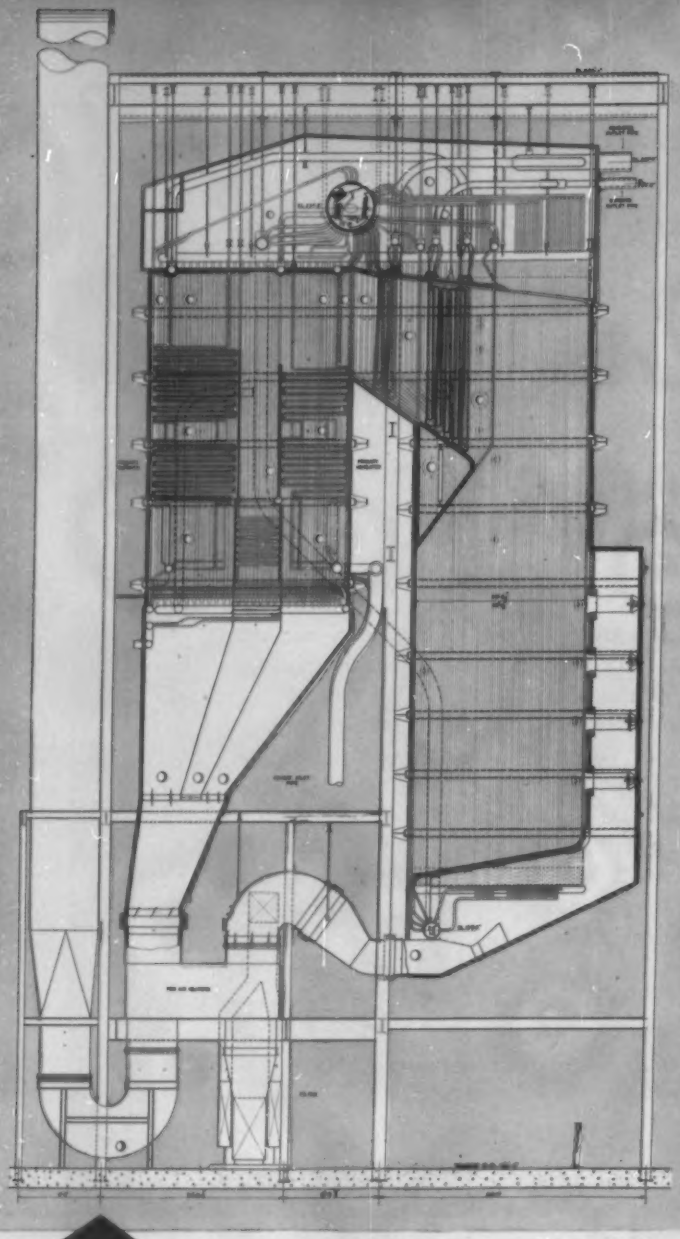
FIG. 1503WE—150-Pound Steel Gate Valve.

FIG. 11323—1500-Pound Motor Operated Steel Pressure Seal Gate Valve.

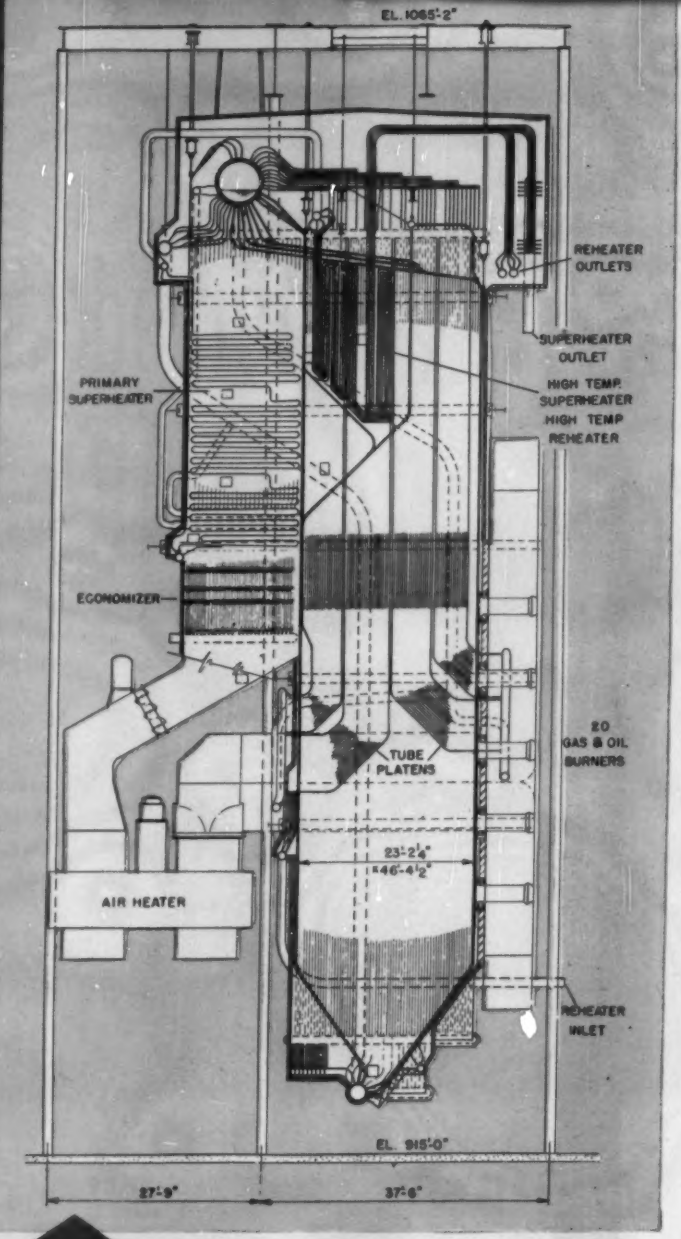
FIG. 19003—900-Pound Steel Pressure Seal Gate Valve.

POWELL VALVES

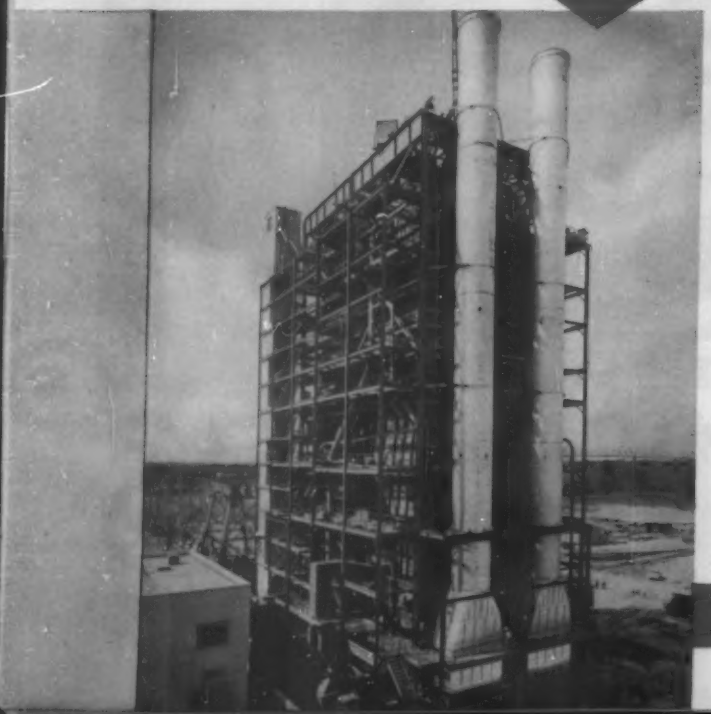
For more data circle 515 on Post Card



Louisiana Power & Light Co., Nine Mile Point Station — Ebasco Services, Consulting Engineers — 1-1,000,000 lbs/hr reheat unit with pressurized furnace — 1725 psig; 1005F/1005F Reheat.



City of Los Angeles — Department of Water & Power — Valley Steam Station 2-1,200,000 lbs/hr reheat units - 2075 psig; 1000F/1000F Reheat.



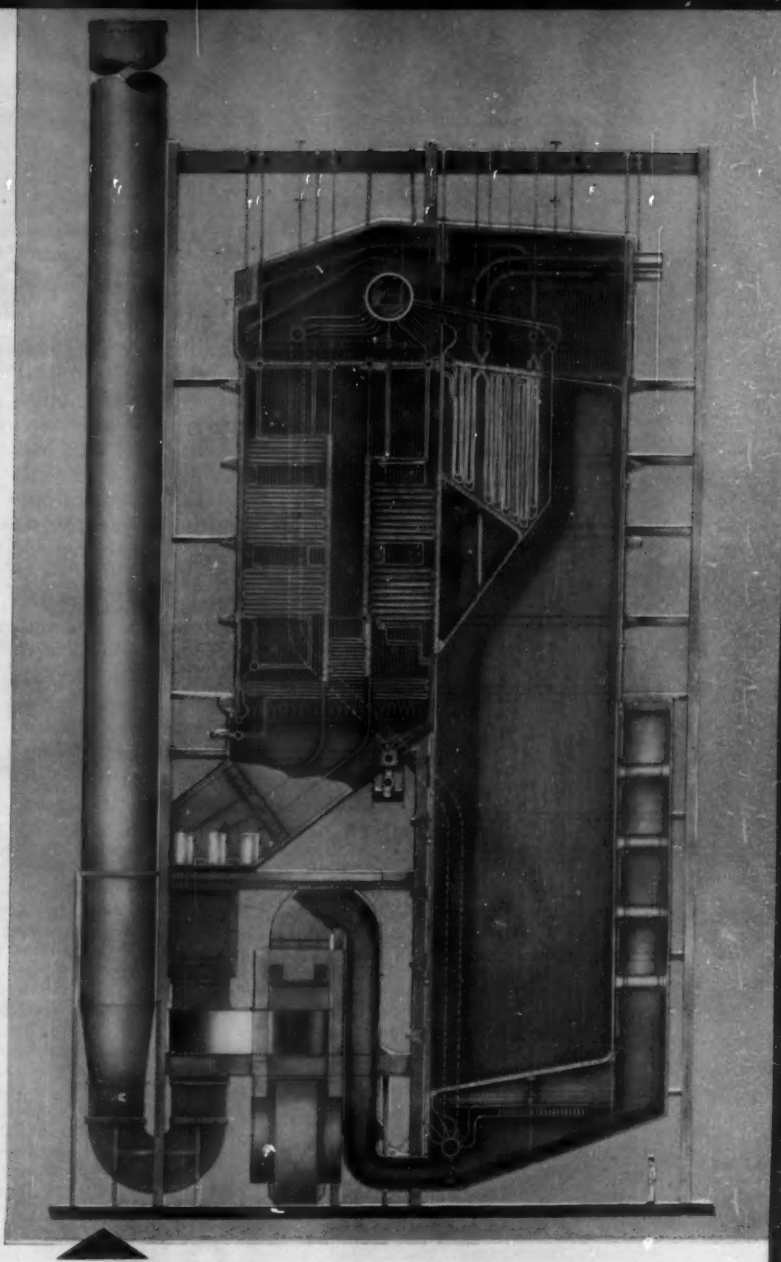
The acceptance of Riley for big reheat and pressurized units by the public utilities . . . the marked swing to Riley has been brought about by outstanding design characteristics such as those found in these three Riley units . . . low furnace exit temperatures through the use of radiant surface preventing objectionable slag formation; wide load range with stable ignition with damper or a combination of damper and spray control; high yearly net efficiency, dependability, and continuity of operation.

A survey of your power plant by your consulting engineer will possibly show ways of making surprising savings in your power costs. There is a Riley representative in all principal cities.

RILEY STOKER CORPORATION • Worcester, Mass.

COMPLETE STEAM GENERATING UNITS AND

for the BIG JOBS more and more public utilities rely on RILEY



Houston Lighting & Power — Deepwater Station and Sam Bertron Steam Electric Station — Ebasco Services, Consulting Engineers — two 1,250,000 lbs/hr reheat units with pressurized furnaces — 2125 psig - 1005F/1005F Reheat.

All of these public utilities have purchased Riley Steam Generating Equipment.

†Dallas Power & Light Co.
†*Texas Electric Service Co.
†*Houston Lighting & Power Co.
*City of Los Angeles, Dept. of Water and Power
†*Louisiana Power & Light Co.
Monogahela Power Company
Potomac Edison Co.
West Penn Power Co.
Arkansas Power & Light Co.
*Utah Power & Light Co.
†*Florida Power Corporation
Florida Power & Light Co.
*Central Illinois Light Co.
†Southern Nevada Power Co.
†*Central Louisiana Electric Co.
Northern States Power Co.
Philadelphia Electric Co.
Commonwealth Edison Co.
Northern Virginia Power Co.
Gulf Power Co.
Pennsylvania Electric Co.
Interstate Power Co.
Ohio Edison Co.
Montana-Dakota Utilities Co.
Mississippi Power Co.
Otter Tail Power Co.
†New Orleans Public Service Co.
†Southwestern Gas & Electric Co.
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FUEL BURNING EQUIPMENT FOR PUBLIC UTILITY AND INDUSTRIAL POWER AND HEATING PLANTS

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Sound Selling vs. Smart Talk

Today, essentially, all of the chemical companies have established technical service and sales-supporting technical work. One corporation has 25 laboratories devoted to this type of work supported by 29 field laboratories. The total investment by the industry in such facilities, must run well into the tens of millions of dollars, which is one measure of how importantly the industry regards the sales function.

It is now estimated that 70% of the average chemical company's sales staff is technically trained compared with probably less than 25% only 20 years ago and an insignificant percentage 30 years ago. This current mode of selling is epitomized in the slogan of one chemical manufacturer, namely, "Serving Industry through Practical Applied Science."

From an article: "Selling . . . Its Importance in the Chemical Industry," by J. Warren Kinsman, Vice-President, E. I. du Pont de Nemours & Co., Wilmington, Del., in Chemical Engineering Progress.

Nalco appreciates the use of its slogan, "Serving Industry through Practical Applied Science", as an example of the modern approach to chemical sales. 100% of Nalco's field service representatives are technically trained to help industry make full practical use of the chemicals and methods developed by the Nalco Laboratories: Water, Microbiological, Physical Chemistry, Organic Chemistry, Corrosion, Micrography, Metallographic, Experimental Boiler, Combustion, Oil Treatment, Paper, Ion Exchange, Weed Control, Production Control.

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*® SYSTEM . . . Serving Industry through Practical Applied Science

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HELPFUL BULLETINS

ELECTRICAL

101 Unit Substations — How compact, enclosureless packaged power at load centers effects installation and operating economies, while stepping-up production and providing for future load demands, is explained in 16-pp Bulletin 102 on unit substations. Covers units on platforms, balconies, basements, outdoors and in production areas. High voltage section equipment, transformers, and low voltage switchgear are also shown. Outdoor "Weather-Loc" construction is described. A fold-out section illustrates high voltage, transformer and low voltage sections as they form the unit substation. Continental Electric Equipment Co.

102 Electric Motors — Twenty types of company's motors are illustrated in 8-pp Bulletin 1878. Illustrated in natural color, the bulletin contains descriptions of Uniclosed, totally-enclosed, explosion-proof, Varidrive, Syncrogear, combination variable speed and internally geared units, right-angle worm gear, and other types. Cut-away views of Varidrive and Syncrogear types are shown, and details on Auto-Start buffers, right-angle hollowshaft gear drive for turbine pumps, and Lubriflush transverse bearing lubrication are included. U. S. Electrical Motors Inc.

103 Enclosed Motors — "Check the Facts," a 12-pp illustrated information booklet, points out 100 characteristic facts of company's totally-protected a-c motors. Included is a classification of the significant points common to all of company's a-c motors, with a further breakdown of information specifically on protected and enclosed motors. Contains data on fan-cooled, corrosion-proof, and explosion-proof designs. Reliance Electric & Engineering Co.

104 Subway Oil Switches — Bulletin 71B6101B gives design, construction features and dimensions of three-pole non-automatic subway oil switches for sectionalizing lines, switching of transformers and similar services. Two types of switches are described — one rated 300 amp, 5000 v, and one rated 400 amp, 7500 v. Allis-Chalmers Mfg. Co.

105 Subminiature Switches — Twelve-pp Catalog 75 covers company's line of subminiature snap-action precision switches, auxiliary actuators, subminiature switches, toggle and push button subminiature switch assemblies. It gives information on company's standard subminiature (single-pole, double-throw) basic switch as well as the long life, high temperature and turret terminal versions. Also presents auxiliary actuators for the switches. Micro Switch Div., Minneapolis-Honeywell Regulator Co.

106 Oil Circuit Breakers — Bulletin GEA-6157, 16-pp, features company's series of high-capacity steel-clad impulse oil circuit breakers in ratings of 138 kv, 161 kv, 230 kv and 330 kv. Advantages of "lens-shape," installation and maintenance, dimensions, accessories, and cross sections are covered. A list of bulletins on equipment ranging from outdoor stations to reclosers for rural lines is included. General Electric Co.

107 Magnetic Amplifiers — Technical aspects of company's magnetic amplifiers for control applications are discussed in 20-pp Technical Data 52–600. Explains basic theory of magnetic amplifier operation, gives information necessary for applications, and describes operating characteristics. A glossary of terms is included. Sections dealing with component parts, applications, and operating characteristics are illustrated with tables, charts, graphs, and circuit diagrams. Photos show uses. Westinghouse Electric Corp.

108 Test Instruments — Data Sheet Series 55 describes company's portable high current test units for safely checking and calibrating electrically actuated protective devices. Information on recommended uses, electrical ratings, component equipment and physical dimensions is included, together with illustrations of each standard model. Multi-Amp Corp.

109 Rubber-Insulated Cable — Bulletin 1090, 36-pp, describes company's rubber-insulated cable constructions, a cost-saving cable design for use in racks or trays for applications where rigid conduit systems are unnecessary or undesirable. Cable with insulation may be operated at conductor temperatures to 85 C both indoors and outdoors at voltages to 15 kv. Current carrying capacities, dimensions, installations and handling techniques, splicing and terminating drawings and instructions included. The Okonite Co.

110 Improved Cable Trough — Sixteen-pp Bulletin 67A introduces a standard cable trough with built-in coupler, designed to ease and speed installation of the cable and reduce the number of parts necessary to join trough sections and fittings. Tells application for this improved cable trough in utilities and in industries. Gives data on the basic unit, elbows, tees, reducers, Y branches, other fittings, and barrier strips. Also provided are tracing templates and load deflection data. T. J. Cope, Inc.

LIGHTING, COMMUNICATION

111 Lighting Unit Standards — A complete compilation of new RLM Specifications is presented in the 48-pp 1955 edition of this authoritative booklet. Covers 46 different types and sizes of incandescent and fluorescent industrial lighting units. In addition, booklet explains reasons for the standards, discusses the basis for the specifications and the objectives of the manufacturers participating in the RLM Inspection and Certification Service. RLM Standards Institute, Inc.

112 Cable for Lighting — Sixteen-pp Publication 19–294, of interest to power engineers concerned with street and road lighting, offers help in selecting the type of cable best suited to a particular installation. Both series and multiple street lighting are discussed. Specification data is given on cables for direct burial, and for use in conduit, duct or open-air as well as for cables for overhead lines. Splicing and terminating methods for various types of insulation are covered. Construction Materials Div., General Electric Co.

113 Mercury Lamp Transformers — Illustrated Bulletin 551–5, 16-pp, gives detailed information on transformers and fuses used in mercury lamp outdoor lighting, and lists advantages of this type of lighting. General information, lamp data, diagrams and illustrations on transformers for both multiple and series circuits are given. Along with installation data, catalog features information on company's line of constant wattage transformers. Jefferson Electric Co.

114 Wire for Sound Systems — Shielded wire and cable for microphone and sound system use is described in illustrated Bulletin SW-1. Covers super flexible and copper shield microphone cables; semi-rigid PVC cables for speech input and sound systems; PVC insulated signal wires; intercommunication cables, others. Whitney Blake Co.

MECHANICAL POWER TRANSMISSION

115 Parallel Shaft Gear Drives — Book 2619, 32-pp, describes parallel shaft gear drives, listing 39 standard size drives for the vibration-free transfer of power, together with baseplates and built-in backstops. Includes complete engineering data, simplified horsepower tables, dimensions, and overhung load capacities for the selection of standard parallel shaft drives. Link-Belt Co.

116 Adjustable Speed Drive — Twelve-pp Bulletin SF-1 describes company's adjustable speed drive, giving construction details, capacities, characteristic torque curves, dimensions, efficiencies and advantages. Contains chart plotting typical torque and load curves, an application data table, and dimensional diagram. Dynamatic Div., Eaton Mfg. Co.

The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 117-118

117 Gear Selection Guide — Engineering Manual DR 2, 30-pp, features company's Duti-Rated lifetime gearing. Standard gear sets are listed by center distance and capacity. In addition to illustrating and listing the line, with specifications, the book contains material helpful in the selection of proper gear sets. Efficient, space-saving gear arrangements are shown and a section lists gear maintenance tips. Foote Bros. Gear and Machine Corp.

118 Eddy-Current Brakes — Standard units in both air and liquid

cooled eddy-current brakes are described in illustrated 12-pp Bulletin BR-1. Points out chief advantages and describes operation and mechanical construction. Application data and specifications are included, as well as capacities and dimensions. Dynamatic Div., Eaton Mfg. Co.

INSTRUMENTS AND CONTROLS

119 Pneumatic Control, Transmission System — Application and operation of pneumatic control and transmission systems are discussed in 46-pp Bulletin 1120. It also covers pneumatic transmission systems and cascades, ratio and other interconnected control systems. Besides design data, bulletin also contains practical information on how to tune pneumatic controllers to a process, how to introduce manual adjustments and how to provide best air supply. Industrial Div., Minneapolis-Honeywell Regulator Co.

120 Liquid Level Control — Bulletin L-119 introduces a control for use primarily with boilers to 250 psi, but applicable to many types of liquid level regulations. Explains how it is used to control a boiler feed pump from the boiler water level, provide a low water fuel cutoff, close an electrical circuit for operating an alarm. Magnetic switching principle is discussed and illustrated, and installation data included. McDonnell & Miller, Inc.

121 Quantity Control Valves — Six-pp Bulletin OG 454 describes methods of industrial liquid metering with multistage quantity control valves, available in iron, steel, 316 stainless and bronze. Bulletin illustrates and describes meters, valves, registers and other equipment. Also features line drawings and descriptions of "typical hook-ups" recommended for specific metering applications. Performance curve and flow range charts are included. Meter and Valve Div., Rockwell Mfg. Co.

122 For Flow Measurement — Information on company's line of Rotameters is presented in illustrated 20-pp Bulletin 115. Includes descriptions of side plate construction and safety features, flow capacity charts, details of design and construction, dimension drawings, tube and float material and design data, various modifications of standard meters and full line of accessory equipment. Brooks Rotameter Co.

123 Combustion Control Systems — How combustion control systems are being used with various types of gas fired boilers is explained in 14-pp Bulletin MSA-116. A series of pictorial diagrams illustrates application of control equipment as boilers increase in size — from the simplest natural draft boiler using a parallel control system to large boilers needing three-element feed water control equipment and interlocking safety devices. Hagan Corp.

124 Load and Frequency Control — Twelve-pp Bulletin 9060 discusses company's load and frequency control system, pointing out such advantages as economy, convenience, dependability of operation. Telemetering totalizers, included in the control when a number of power measurements must be added, are described, as well as electronic servo techniques, the incremental loader, positive governor adjustments, and operation. Industrial Div., Minneapolis-Honeywell Regulator Co.

125 Controls for Nuclear Reactors — Folder ND46-70-700(1), 8 pp, introduces a package control system for nuclear power reactors. The system includes design, instrumentation, and fabrication of the complete control, and use of company's standard components for accurate control without elaborate customizing. Booklet discusses operating and safety channels incorporated. Leeds & Northrup Co.

126 Trough for Tubing — Bulletin 1254-D, 8 pp, introduces Tubetrof, a new simplified standard system for supporting instrument tubing which offers savings in design, fabrication and installation. Bulletin discusses these and other advantages offered, describes and illustrates the trough, covers, and fittings. Includes sizes. P-W Industries, Inc.

VALVES, PIPE FITTINGS

127 Safety Valves — In Catalog 400-HC, 16 pp, the flow pattern through company's high capacity safety valves is visualized to show how contour design affects turbulence and eddies in flowing medium. Of interest to those concerned with use of steam above 1000 psi, this brochure presents design information plus data on saturated steam capacities, superheat correction factors and valve material specifications. Offers excellent aid in selection of proper safety valve for high-capacity, high-pressure steam generating units and related superheaters, reheaters. Crosby Steam Gage & Valve Co.

128 Motorized Valve Assemblies — Technical data on industrial motorized valve assemblies is presented in 6-pp Bulletin 8506. Information on the selection of valve bodies, linkages, and power units is offered, along with references to other sources of data on the subject. A list of available valve body and electric operator combinations in tabular form is included. Industrial Div., Minneapolis-Honeywell Regulator Co.

129 Stainless Steel Pipe Fittings — Bulletin S-3-55 describes company's 150 lb stainless steel pipe fittings for corrosive, high and low temperature service, including 90 deg elbows, tees, 45 deg elbows, crosses, couplings, reducers, pipe caps, unions, plugs and bushings. Presents dimensional specifications in sizes ⅛ to 2 in. in both screw end and socket welding types. Applications in chemical plants, refrigeration service, food and other process piping given. Watson-Stillman Fittings Div., H. K. Porter Co., Inc.

PUMPS, COMPRESSORS

130 General Purpose Pumps — Section B, 36 pp, describes rotary pumps for general purpose use. Explains positive displacement principle incorporated, gives suggestions for selecting proper materials of construction. Application and ordering information is provided on mounted and unmounted small pumps, large mounted pumps, pumps for operations requiring greater sealing, and large, totally enclosed models. An engineering section covers recommended speeds and capacities for handling various liquids. Viking Pump Co.

131 High Vacuum Pumps — Catalog 400 describes company's mechanical booster high vacuum pumps. Points out advantages of the two-stage construction, and illustrates characteristics in metallurgical vacuum processing, metallized coating, and pharmaceutical applications. A cutaway view is included, together with performance curves which show typical pumping speed, throughput, and horsepower vs. inlet pressure. Kinney Mfg. Co. The New York Air Brake Co.

132 Centrifugal Pumps — In Selection Charts and List Price Sheet CSP-155, 8-pp, are capacity charts and dimensions to aid in selection of company's centrifugal pumps, as well as price lists for available models. Photos and diagrams supplement the tabulated data. Bell & Gossett Co.

133 Pump Engineering Data — Forty-pp Section K is devoted to engineering data on this manufacturer's line of rotary pumps. In it rotary pump fundamentals are explained in everyday language as an aid to proper selection and installation. A 10-step method for selecting the correct pump for the job is presented in detail, covering temperature considerations, materials of construction, horsepower requirements, determining pressure, determining size of discharge piping, mounting and drive arrangement, size of pump, determining viscosity of liquid, and determining capacity. Viking Pump Co.

134 On Cooling Tower Pumps — This 8-pp bulletin is a six-step manual for sizing cooling tower pumps and piping. Patterned after procedure used in company's handbook, by means of six simple steps, the most efficient and economical selection of cooling tower pumps and piping can be made. A selection chart and price list is included, and typical cooling tower installations are diagramed. Bell & Gossett Co.

135 Air Compressor — Eight-pp Bulletin 602 describes construction and design features of company's Class HAE two-stage angle compressors available in 125 and 150 hp, with pressures to 125 psi. Sectional drawings illustrate component parts, and descriptive paragraphs on construction, design, operation are included, as well as dimensional data. Pennsylvania Pump & Compressor Co.

FANS, BLOWERS

136 Induced Draft Fans — Eight-pp Bulletin SI-101 covers this company's line of Spid induced draft fans — packaged units including fan, motor, motor base and adjustable speed V-belt drives. Stresses constant boiler draft, quiet operation, low maintenance and other advantages. Details construction features and provides dimensions, sample specifications and installation suggestions. Includes selection table. Chicago Blower Corp.

137 Utility Fans — Bulletin DS-348U, 24-pp, describes company's redesigned and expanded line of utility fans. Lists advantages of the belt-driven and direct-drive centrifugal fans, their construction features, and special features for specific types of applications. Fan selection data, capacity tables, roughing-in dimensions, and mechanical specifications are included. The Trane Co.

WELDING AND MACHINE SHOP EQUIPMENT

138 How to Straighten Pipe and Tube — Technical Bulletin 55, 24-pp, covers the general subject of straightening ferrous and non-ferrous pipe and tube, reviewing recent uses for tubing. The reasons for having straight tube prior to forming

why soot is no problem... with the Ljungstrom® Air Preheater

Soot is no problem with the Ljungstrom. Clinging soot or slag is loosened by normal expansion and contraction of the preheater . . . and most of it is blown away by the high-velocity gas streams. What remains is removed by superheated steam or compressed air, fired from oscillating soot blowers, while the Ljungstroms are in operation.

What's more, moderate deposits on the Ljungstrom heating surface have no effect on preheating. For, with the Ljungstrom, heat need not pass through a film-coated wall — but is simply absorbed by a heating surface and *released from the same surface.*

Get all the details on why the Ljungstrom is easier to clean and maintain . . . maintains higher boiler efficiencies. They're in the new, 38-page reference manual, "Ljungstrom Air Preheaters." Write for your free copy, today!

Advantages of the Ljungstrom Air Preheater

- Size for size, recovers more heat than any other type.
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- Easier, faster to clean and maintain.
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by Eliminating Corrosion

Even when an efficient deaerator removes free carbon dioxide from your system, additional CO_2 produced by decomposition of bicarbonates and carbonates remains to cause return line corrosion. Residual oxygen causes pitting. Protecting against both CO_2 and O_2 considerably reduces the cost of replacing and maintaining steam and return lines. Keeping the system free of corrosion products assures high heat transfer efficiency.

One series of Allis-Chalmers corrosion inhibitors solves this problem by neutralization. These materials are blends of the most effective amines selected according to the volatility characteristics required by each steam condensate system. Protection is provided against both CO_2 and O_2 at the points where it is needed.

Although recommendations for your specific needs can be made only after thorough analysis, you can get more information about use of this series by obtaining a copy of Allis-Chalmers Water Conditioning Informational Bulletin 50. Get a copy from your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

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Water Conditioning—Chemicals, Equipment, Service—for more than 25 years

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and fabricating operations are presented. Several pages analyze basic straightening methods — two plane vs. rotary machines. Detailed explanation is given on merits of rotary straightening. Discusses adjustment and operation of the straighteners; design and use of entry and delivery tubes. Mackintosh-Hemphill Co.

139 Welding Machines — This 54-pp catalog describes company's welding machines, automation machines and special machine tools. Forty-six individual types of automatic welders for submerged arc, resistance and Heliarc welding operations are described and illustrated. Automatic assembly and automatic nut torquing machines are described, as well as special machine tools including horizontal and vertical boring machines and drilling and tapping machines. Expert Welding Machine Co.

140 Tooling for Welding — A 40-pp illustrated catalog describes company's standard and special tooling, fixtures and machinery for high quality, high speed, low cost welding. Includes examples of special purpose automatic welding machinery using submerged arc and inert arc (MIG and TIG) processes. Illustrations, descriptions and specifications are given for all models. Cecil C. Peck Co.

141 Welding Equipment — Catalog 9–13, 36-pp, covers company's complete line of arcwelding and oxyacetylene welding supplies and accessories, featuring product descriptions and specifications. Included are welding rods, fluxes, brazing alloys, goggles, helmets, shields, electrode holders, protective clothing, cable, clamps, hose, lighters, cylinder trucks and carrying cases. Air Reduction Sales Co.

Postage-free cards for ordering catalogs are on pages 117-118. You may also use the cards to ask for further information on the advertised products.

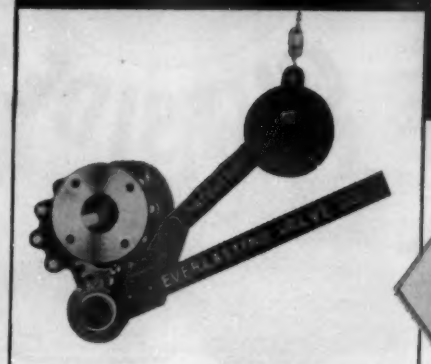
142 Brazing Manual — Concerned with application of major brazing methods in joining metals using silver alloys and filler metals, fluxes, and gas atmospheres, this 22-pp brazing manual (Catalog 925) contains over 20 tables, drawings and photographic illustrations. The subjects discussed include silver brazing procedure, selection of brazing and filler metals, design of brazed joints, prebraze cleaning, assembly of brazed joints, and others. Air Reduction Sales Co.

143 Bearing Pullers — How Tracta ball and roller bearing extractor overcomes disadvantages associated with many types of bearing pullers is told in this illustrated bulletin. Describes performance in various applications, points out design features which result in lower maintenance, savings in time and labor. Drawings illustrate operation, and a list of sizes is included. Engineering Imports.

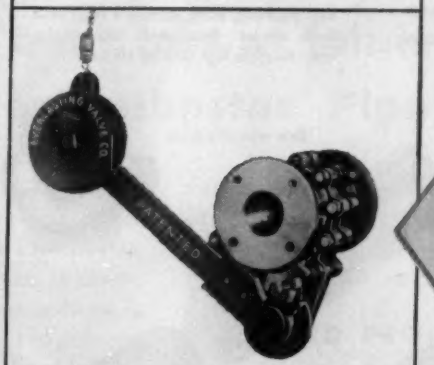
ENGINES

144 Diesel Engines — Bulletin S-500-B52B, 8-pp, describes company's diesel engines for use in municipal power plants, water works, sewage treatment plants, and similar applications. Explains operation using oil, oil and gas, dual fuel

For Everlasting Protection in Emergencies



OPENING TYPE
to divert water to sprinkler deluge or water curtain systems, or to divert inflammable liquids to a point of safety.



CLOSING TYPE
to shut off the flow of inflammable liquids or to concentrate water or steam in fire mains.

Write for Bulletin E52C

Both types can be controlled thermostatically, electrically, or manually from any or many locations. Their design assures positive, dependable protection because they do not wedge and consequently cannot stick.

EVERLASTING Valves

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EV30I

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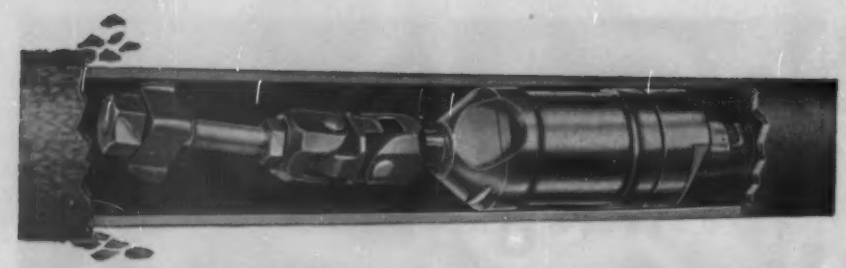

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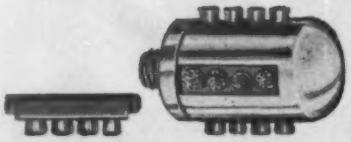
Cleans Fire Tubes ▸▸▸▸▸▸ FAST ▸▸▸▸▸▸▸ INSIDE and OUTSIDE

You can now clean fire tubes inside as well as outside faster with a new Rotojet. The new Rotojet is the most powerful tube cleaner we ever built. It won't stall at low speeds caused by heavy loads. Roto expanding heads and brushes thoroughly clean soot scale inside tubes. A Roto vibrating head (illustrated above) knocks off water scale adhering on the outside.

Try the new Rotojet, and no other tube cleaner will ever satisfy you.

Economical Roto Brushes

Roto expanding brushes and heads have separately replaceable wearing elements. These inexpensive parts save time, money, and critical materials. Send for details.



Roto expanding brush, showing a replaceable brush element. Brings down tube cleaning cost. Maintains high cleaning efficiency.

Roto solid wire brush.

Model S525 ROTOJET Air-driven Motor with swing-frame head for 3" O.D. tubes.

Model S505 ROTOJET Air-driven Motor with 2-arm head for 2" O.D. tubes.

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and spark ignition gas. A chart lists ratings for 5, 6, 7, and 8 cylinder engines which are available in from 550 to 2200 hp. Sectional drawing shows major mechanical features and gives specific parts descriptions. Charts show fuel cost curves; application photos are included. Worthington Corp.

145 Power Units — Eighteen heavy-duty power units from 55 to 190 hp are covered in this illustrated 12-pp bulletin. Describes each model and gives full specifications on each. Tables listing horsepower ratings for carbureted and diesel power units are included with other data. International Harvester Co.

. . . Outstanding Among This Month's Catalogs

146 Liquid Level Control Systems — Bulletin 1161, 24-pp, includes a discussion of the basic principles of liquid level measurement, control, and transmission. Systems are described in detail along with applications, principles of operation, limitations and advantages. Various types of instrumentation are surveyed on a comparison basis. A tabulation of liquid level controlling systems and measuring systems record applications, components, principles of operation, ranges, limitations, advantages, and references to further data. Numerous diagrams supplement text. Minneapolis-Honeywell Regulator Co.

147 Guide to Instrument Transformers — The 1955 edition of this instrument transformer buyer's guide, 100-pp Bulletin GEC-1028 contains basic information on company's complete line. Fully illustrated, book contains ratings, ASA accuracy classifications, and prices of all standard indoor and outdoor potential and current transformers. Listings of ratio and phase-angle tests, tables of replacement types, and mechanical and thermal data are included. Designed to save time in selecting and ordering current transformers, potential transformers, and metering outfits, this book supplies pertinent data on all standard types that conform to ASA insulation standards. Available to qualified power engineers. General Electric Co.

148 Data on Insulations — Insulation solutions for a wide range of temperature problems are charted in this folder. Provides brief descriptive information and tells forms available for high temperature applications, for intermediate temperature use, for hot and cold water and low pressure steam, for ice water and frigid temperatures, and other uses. Mundet Cork Corp.

149 Tubing Guide —Eight-pp Bulletin 40 condenses pertinent information on selection and applications of 46 principal analyses of tubing. Groups these into five classifications — stainless steel, nickel and nickel alloys, carbon and alloy steels, beryllium copper and titanium. A summary of the principal properties of each and its normal production limits given. Properties of six glass sealing alloys are included. Describes manufacturing processes of tubing and lists length limits, straightness tolerance, temper designations and tolerances. Superior Tube Co.

Less heat loss at joints with single-layer Unibestos® Pipe Insulation

Tests prove that Unibestos single-layer pipe insulation actually provides greater protection than other nonfibrous *double-layer* insulations which cost more to install. Unibestos is made of Amosite—the long-fibered African asbestos. These fibers interlock with one another to prevent heat loss at horizontal and longitudinal joints.

While most insulating materials show a pronounced shrinkage at high temperatures, Unibestos has no measurable shrinkage at 1200°F. It will not powder, pulp or wash off, even under heavy moisture conditions, and when dry, Unibestos resumes its original thermal and physical characteristics.

EASY to install. . . easy to remove.

Unibestos can be cut, mitered and handled easily. The fabrication of insulation for tees, valves, flange covers, etc., is a fast, low-cost operation. Because of its unusual strength and durability Unibestos can be removed and replaced with little or no loss of material.

STANDARD PRODUCTION SIZES

Unibestos Pipe Insulation is regularly made in 3-foot lengths for pipe sizes from ½″ through 24″, in standard thicknesses through 5″. Unibestos Block Insulation is made in 6″, 12″, 18″ or 36″ widths and in thicknesses from 1″ through 3″ in ½″ increments.

For complete information, write for descriptive Bulletin 109C

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Where you need

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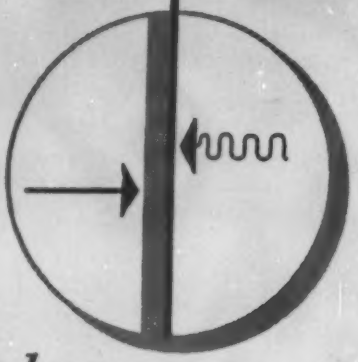
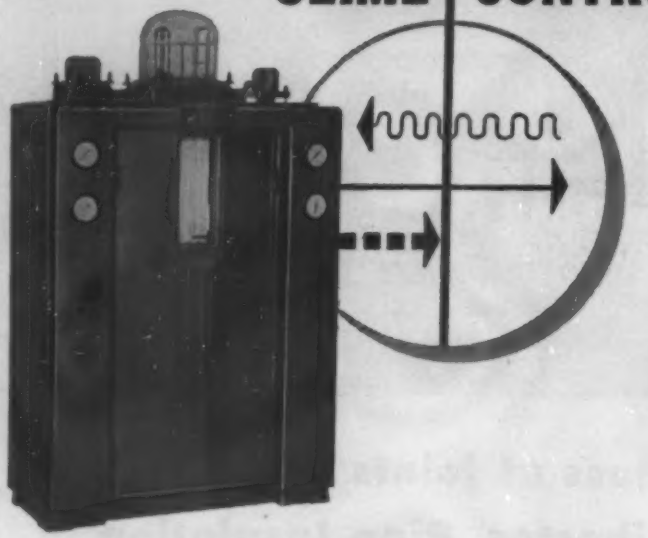


Be sure you have

SLIME | CONTROL



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

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LUBRICANTS

150 Long-lasting Lubricant — Technical information and performance data on company's silicone fluid-carbon black mixture for high temperature, slow speed bearings are provided in this 6-pp brochure. Presents illustrated case histories detailing actual savings in relubrication schedules, replacement and maintenance costs. Applications discussed include injection valves, turbine governors. Specifications and typical properties are also given. Dow Corning Corp.

151 Colloidal Graphite — Bulletin 421 contains photos, diagrams, charts, and general information on the advantages offered by colloidal graphite in the assembly and run-in of machines. Shows how to use colloidal graphite, chiefly as a petroleum oil dispersion. Acheson Colloids Co., Div., Acheson Industries, Inc.

FILTERING, SCREENING

152 Diatomite Filters — Bulletin 5502 explains how the diatomite filter works, illustrating the operation with a series of sectional drawings. Precoating, filtering and cleaning are shown in three steps. Points out applications, describes construction features. General Filter Co.

153 Vibrating Screens — Twelve-pp Book 2554 describes a complete line of vibrating screens for all medium and heavy duty screening operations. Contains valuable information — including a capacity chart — to aid in selecting a vibrating screen for use with a given material at a specific capacity. Link-Belt Co.

154 Filter Fabric Facts — This 16-pp illustrated booklet contains information about filtration principles; filtering devices; filter media; textile fibers for filtration; a comprehensive chart on chemical and heat resistance of cotton and synthetic fabrics; sections on yarns, fabric construction and finishing; and a round up of filter fabrics in use. Photos illustrate variety of filter fabrics being produced for industrial use, and specifications for typical ones are given. Wellington Sears Co.

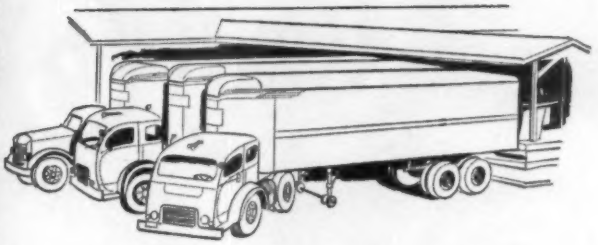
WATER TREATING

155 Handbook on Demineralizing — Comprehensive 40-pp Bulletin 5800-B compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to use 2-bed, 3-bed, 4-bed, mixed or mono-bed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

156 Hot Process-Zeolite Treatment — Technical Reprint T-128, 6-pp, describes boiler feedwater treatment in a steel mill. Discusses problem raised by an expansion in power-generating facilities and the solutions found for them. There is a comprehensive explanation of the mill's operations, water requirements and possible raw water sources. The treatment system, centering around the Sphericone, that was installed to provide the necessary water is described, and its performance and effect on existing facilities are evaluated. Graver Water Conditioning Co.

— more Bulletins on page 126

Roy Fruehauf, President, Fruehauf Trailer Company



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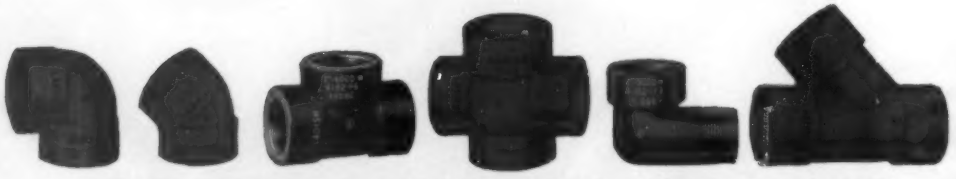

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Portrait by Fabian Bachrach

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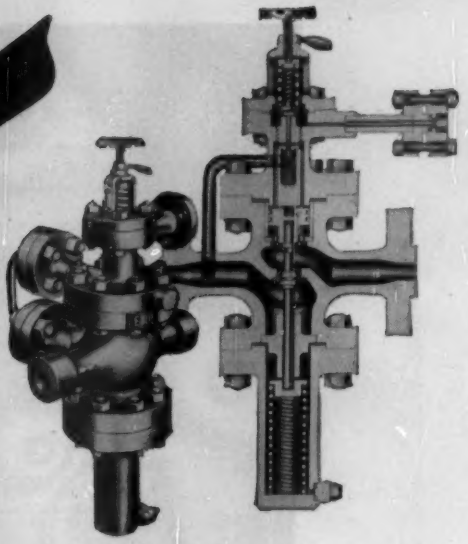

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- **For Steam, Air, Gas**
- **99% Accuracy of Regulation**
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- **Positive Dead-End Shut-Off**
- **Interchangeable Parts**

BULLETIN 5302

Provides latest engineering data on all classes of Leslie Pressure Reducing Valves—assists you in planning and specifying for optimum performance. Yours on request.

TYPICAL PRESSURE RANGES

CLASS	BODY MATERIAL	SIZES	INLET STEAM PRESSURES	REDUCED PRESSURE RANGE
LLK	Cast Iron	½"-6"	25-250	2-35
LK	Cast Iron	½"-6"	25-250	10-235
LL-3	Cast Bronze	½"-4"	25-300	2-35
L-3	Cast Bronze	½"-4"	25-300	10-285
LL-4	Cast Bronze	5"-6"	40-300	5-35
L-4	Cast Bronze	5"-6"	40-300	20-275
IS-2	Cast Carbon Steel & Cast Alloy Steels	½"-3"	300-750	100-600
HS-3		1"-3"	300-1500	100-600

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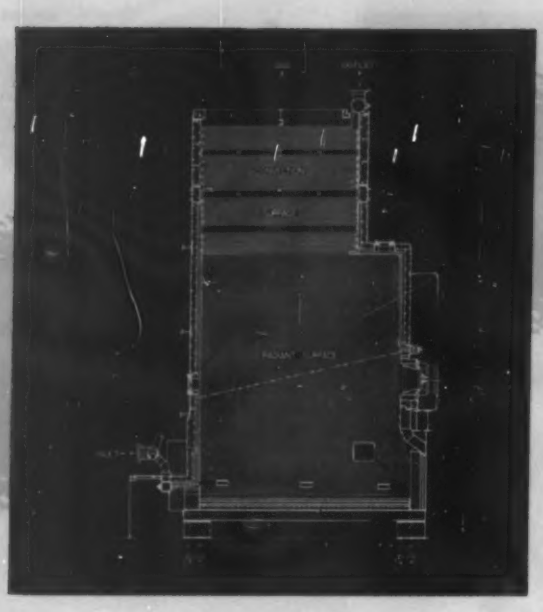

The New C-E La Mont Controlled Circulation Hot Water Boiler

For those applications where high temperature water has inherent advantages over steam—and there are many—the C-E La Mont H T Boiler has numerous points of superiority. Among the more important of these are:

1. **Complete control** over HT water movement in both system and boiler.
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3. **Pressurized operation** with oil or gas means no induced draft fan—simple stack.
4. **Single-pass design** has no baffles—low draft loss—cleaner boiler.
5. **More efficient heating surface** can be arranged because of positive, controlled circulation.
6. **Other features** such as: steel enclosed setting—few headers, all accessible—any fuel, oil, gas or coal.

Available in sizes ranging from 15 to 150-million BTU per hour, or more—for pressures to 300 psi and temperatures to about 425 F.

MEET YOUR HEATING OR PROCESS NEEDS WITH ONE OF THESE C-E BOILERS

If you need steam—from 4,000 to 60,000 pounds per hour... or high-temperature water for heating or process applications... one of the three C-E Boilers shown here will fit your needs *exactly*.

Collectively they offer an exceptional diversity of choice, and a brief consideration of the features of each will help to "pin point" the design characteristics suited to your situation.

Of course, if larger capacities are needed the Combustion line includes boilers of any capacity—for any pressure—for any fuel or method of firing.

Please feel free to call upon us for further detailed information. Catalogs of each of the units illustrated are available upon request.

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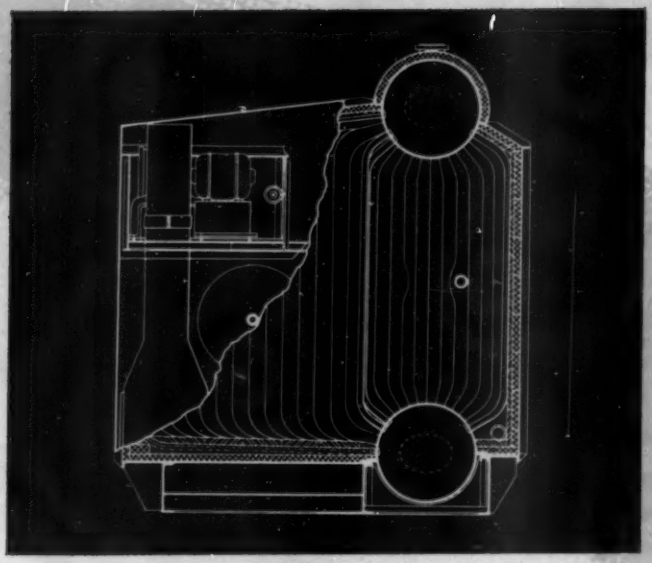
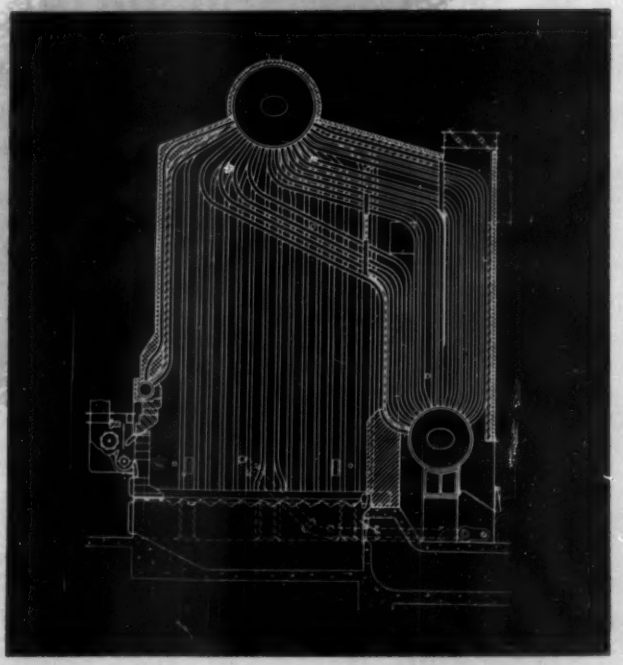


The C-E Package Boiler, Type VP

This completely shop-assembled boiler is available in fourteen sizes from 4,000 to 42,000 pounds of steam per hour . . . for design pressures up to 500 psi . . . up to 200 degrees of superheat available in sizes above 21,000 pounds capacity . . . for pressure firing of liquid or gaseous fuels. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large lower drum—30-inch diameter—permits a simple, symmetrical tube arrangement . . . greater storage capacity . . . easy access for washing down or inspection. A centrifugal fan, which operates at low speed and is exceptionally quiet in operation, is standard equipment. The simple baffle arrangement results in low draft loss . . . simple soot blowing . . . no dead pockets . . . high heat absorption. The VP is enclosed in a reinforced, gastight, welded steel casing, and shipped completely assembled with firing equipment, fittings and forced draft fan. For foundation, it needs only a simple concrete slab.



The C-E Vertical-Unit Boiler, Type VU-10

The VU-10 is available in nine sizes from 10,000 to 60,000 pounds of steam per hour . . . for design pressures up to 475 psi . . . up to 200 degrees of superheat available in 20,000-60,000 lb range . . . for solid, liquid, or gaseous fuels. This boiler is a completely standardized design adaptable to many conditions. Like the VP Boiler the VU-10 is particularly well suited to plants having small operating and maintenance forces. It is bottom-supported and needs no outside supporting steel. It performs efficiently over a wide range of output, and is easy to operate and to maintain. All parts are easily accessible for inspection. The VU-10 is a complete unit—boiler, furnace setting, fuel-burning equipment, controls, forced draft, heat recovery equipment (if desired). Regardless of fuel or method of firing, the same general cross-sectional arrangement of drums, convection bank and furnace wall cooling is used.

For more data circle 526 on Post Card

CONSTRUCTION NEWS

Petersburg, Alaska — Town Council, Petersburg, has completed plans for new hydroelectric power plant at Blind Slough, about 17 mi. distant, and will begin work soon. Project will include power house, penstock, dam and associated structures, with hydraulic turbine, electric generator and auxiliary equipment. A 22,000-volt transmission line will be constructed to municipality. No estimate of cost announced. R. E. Beck & Associates, Tower Bldg., Seattle, Wash., are consulting engineers.

Maricopa, Ariz. — Electrical District No. 3, Pinal County, Maricopa, plans new steam-electric generating plant on local site, to be equipped for an initial capacity of 30,000-kw. Cost estimated about $4,800,000. Proposed to arrange bond issue in amount of $6,740,000, for construction of station, transmission lines in different parts of county for power supply for irrigation pumping plants, power substations and other operating facilities.

Phoenix, Ariz. — Arizona Public Service Co., Phoenix, plans an expenditure of about $16,000,000 for new construction in 1955, including generating facilities, power substations, transmission lines, etc. Program will comprise work on new steam-electric generating station at Tempe, Ariz., with capacity of 100,000-kw., previously noted in these columns.

Blytheville, Ark. — Arkansas-Missouri Power Co., Blytheville, has disposed of a block of stock, totaling 36,868 shares, to net several million dollars. Proceeds will be used for extensions and improvements in power plants, power substations, transmission lines and other operating facilities.

Pine Bluff, Ark. — Arkansas Power & Light Co., Simmons National Bldg., has disposed of a bond and stock issue to total about $27,000,000, portion of proceeds to be used in connection with 1955 expansion and improvement program, including generating facilities, power substations, transmission lines and other work.

Riverside, Calif. — California Electric Power Co., Riverside, has arranged a construction program to cost about $11,500,000 in 1955. Work will include installation of new turbine-generator at power plant at Highgrove, near Riverside, making fourth unit at plant; extensions in power substations, transmission lines and other operating facilities.

San Francisco, Calif. — California-Pacific Utilities Co., 405 Montgomery St., with power plants at Needles, Calif., and other points, has arranged financing through sale of preferred stock to total about $1,000,000, proceeds to be used for expansion and improvements in power stations and other operating facilities.

Bridgeport, Conn. — United Illuminating Co., 80 Temple St., New Haven, Conn., has plans maturing for new steam-electric generating station on West side of Bridgeport Harbor, Bridgeport. Proposed to begin work on foundations at early date. Details of installation are being determined, including turbine-generator, high-pressure boilers and accessories. No official estimate of cost announced — this will be a multi-million dollar project.

Miami, Fla. — Florida Power & Light Co., Miami, has disposed of a stock issue totaling about $18,600,000, proceeds to be used in connection with 1955 expansion and improvement program, estimated at $41,300,000, as recently noted in these columns. Work on different phases of program is being placed under way.

Savannah, Ga. — Savannah Electric Power Co., 27 West Bay St., is considering purchase of tract of about 58 acres of land fronting on Savannah River, as site for new steam-electric generating station, supplementing present Riverside plant. Company has petitioned Board of Chatham County Commissioners for easement rights on property. Project is now in preliminary stage, with details of installation to be determined later. New plant will represent a multi-million dollar investment.

Chicago, Ill. — Northwestern University, 619 Clark St., Evanston, Ill., J. C. Sanderson, in charge, plans boiler plant for central-heating service in connection with new school building at 330 East Ontario St., Chicago. Installation will include boiler units, stokers and accessory equipment. Olsen, Urbain & Sandstrom, 5 South Wabash Ave., are architects; and Neiler, Rich & Bladen, 343 South Dearborn St., mechanical engineers, both Chicago.

Manilla, Iowa — Municipal Service Department has plans for extensions and improvements in municipal oil engine-operated electric plant, with installation of new Diesel engine generator unit and accessory equipment. No estimate of cost announced.

Topeka, Kan. — Kansas Power & Light Co., 808 Kansas Ave., plans extensions and improvements in Tecumseh steam-electric generating station, with installation of new turbine-generator unit and auxiliary equipment. Cost reported about $2,000,000. Bechtel Corp., 3780 Wilshire Blvd., Los Angeles, Calif., is consulting engineer.

Wichita, Kan. — Kansas Gas & Electric Co., 215 North Market St., has arranged financing in amount of about $16,000,000 through sale of bonds and preferred stock, portion of proceeds to be used in connection with 1955 expansion and improvement program, including power facilities, power substations, transmission lines and other work.

Concord, Mass. — State Department of Correction, Division of Building Construction, 38 Chauncy St., Boston, Mass., has plans under way for new power plant at Massachusetts Reformatory, Concord. Cost reported close to $1,000,000, with equipment. Merrill Associates, 210 South St., Boston, are consulting engineers.

Berrien Springs, Mich. — Berrien County Board of Commissioners, Berrien Springs, has plans under way for power house for central-heating service and mechanical laundry unit, estimated to cost about $300,000, to be located at new county home for aged, to be constructed at same time, to cost approximately $1,000,000. Cuthbert & Cuthbert, Dearborn, Mich., are architects.

St. Louis, Mo. — Catholic Preparatory School for Boys, 220 North Fourth St., Fred M. Switzer, president, plans power house for heating service at proposed new school, consisting of several buildings on 50-acre tract of land on Conway Rd., vicinity of Mason Rd. Entire project reported to cost about $1,500,000.

Glendive, Mont. — Montana-Dakota Utilities Co., 831 Second Ave., South, Minneapolis, Minn., is arranging fund of about $8,000,000 for expansion and improvements in 1955, including generating plants, power substations, transmission lines and other operating facilities.

Las Vegas, Nev. — Southern Nevada Power Co., South Second St., has arranged financing through sale of preferred stock, to total $1,500,000, proceeds to be used in connection with new steam-electric generating station, on which work is under way. It will be equipped for an initial capacity of 44,000 kw.

Newark, N. J. — Public Service Electric & Gas Co., Public Service Terminal, will expand about $90,000,000 on new construction in 1955, including generating stations, power substations, transmission lines and other facilities. Program will allocate a substantial part of fund for construction of new steam-electric generating station at Linden, N. J., previously mentioned in these columns.

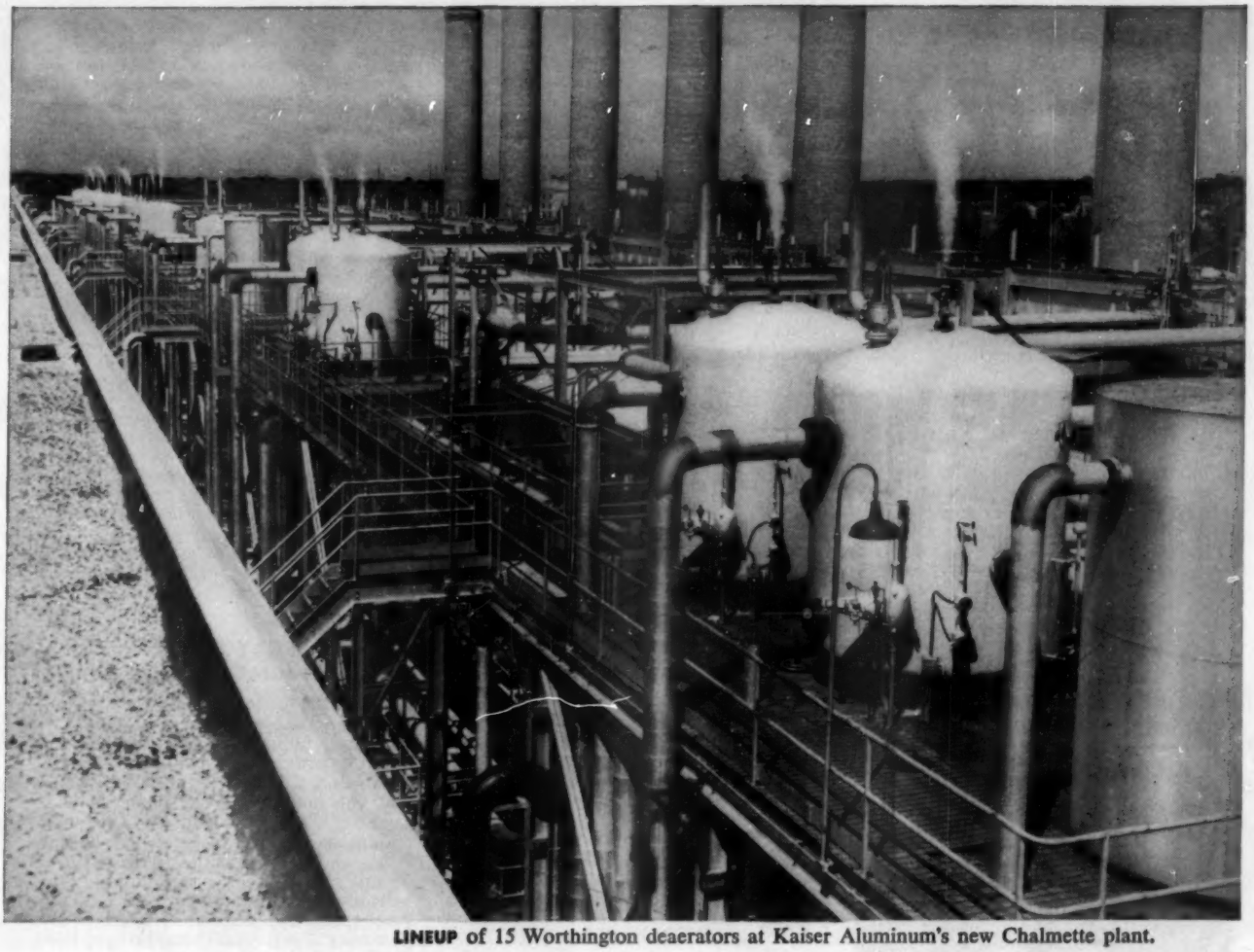
Akron, Ohio — Ohio Edison Co., Akron, is reported planning new steam-electric power plant in Bath Township, with installation of turbine-generator, high-pressure boilers and auxiliary equipment. Cost estimated about $15,000,000, with extensions in transmission lines, power substations, other operating facilities.

Philadelphia, Pa. — Philadelphia Electric Co., 1000 Chestnut St., will expend about $70,000,000 for new construction in 1955, including generating stations, power substations, transmission lines and other operating facilities. As previously noted in these columns, plans are in progress for a new steam-electric generating station, to cost close to $45,000,000, on which work is expected to begin in 1955.

Abilene, Tex. — West Texas Utilities Co., Third St., has arranged for sale of a bond issue to total $7,500,000, proceeds to be used for extensions and improvements in power facilities, power substations, transmission lines, other work during present year.

Ashland, Wis. — Lake Superior District Power Co., 101 Second St., West, plans addition to steam-electric generating station on bay front, with installation of new 25,000-kw. turbine-generator unit and auxiliary equipment. Extensions will be made in coal storage and handling facilities. Estimates of cost are being made.

Madison, Wis. — Madison Gas & Electric Co., 100 North Fairchild St., will have plans prepared by Pioneer Service & Engineering Co., 231 North LaSalle St., Chicago, Ill., consulting engineer, for proposed addition to local generating plant, recently noted in these columns. Installation will include new turbine-generator, high-pressure boilers and auxiliary equipment. Cost reported about $9,000,000.



LINEUP of 15 Worthington deaerators at Kaiser Aluminum's new Chalmette plant.

Biggest U.S. aluminum plant has 15 Worthington deaerators

Kaiser Aluminum's mammoth new reduction plant at Chalmette, La., turns out 12½ pounds of aluminum *every second.*

It takes nearly half a million kilowatts (enough to power a city of 1 million) to sustain Chalmette's rated production of 400 million pounds a year. And the Worthington nameplate pops up everywhere you look in Chalmette's two big powerhouses.

The deaerators are Worthingtons — 15 of them, each with a capacity of 250,000 pounds per hour. These compact and efficient deaerators are of the Full Contact Steam Jet Type. Vent mixture is effectively concentrated by direct contact within the deaerator shell, thus obviating the need for a surface type vent condenser. A troublesome source of maintenance is thereby eliminated, installation is simplified, and cost of lagging is substantially reduced.

Worthington condensers, condensate and circulating pumps, boiler feed pumps and deaerators are all helping to keep Kaiser's Chalmette plant on the line. For the whole story on Worthington deaerators write for Bulletin W-210-B32 today. Address Worthington Corporation, Steam Power Division, Harrison, New Jersey. S.4.3

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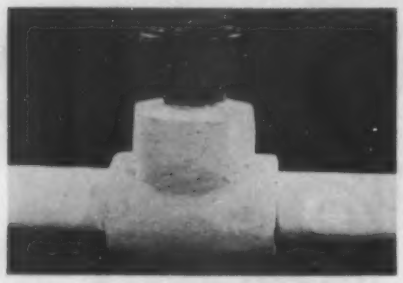
EQUIPMENT NEWS

1—CABLE CONSTRUCTION for the hot locations

Okotherm-insulated, aluminum-sheathed cable is designed for continuous operation at 150 C and up to 200 C under certain conditions. Available for both power and control cable circuits, the cable is said to provide labor-saving advantages through its own built-in aluminum conduit. The chief advantages are announced as flame and heat resistance; moisture and ozone resistance; space-saving small diameter; light weight for easy handling; high dielectric strength; corrosion resistance. Bulletin 1088 gives data. The Okonite Co.

2—INSULATING CEMENT provides smooth finish

Super Powerhouse Cement is announced as a white insulating-finishing cement which provides both insulating properties and a smooth, white finish when applied alone or over regular insulating cement, block, blanket and other thermal insulation. When applied as the only



insulating material on valves, flanges, fittings and other irregular surfaces it gives a white finish which blends completely with adjoining white insulations.

Made of long, fine fibers of spun mineral wool, the cement is said to offer better adhesion, easier mixing and improved handling and troweling qualities while retaining the characteristic density, coverage, low shrinkage, and high thermal efficiency of mineral wool cements. It can be used to temperatures of 1700 F and has a glazed white surface when finish-troweled. The hydraulic-setting material remains workable for one hour, sets to initial hardness within two to three hours, and according to manufacturer will withstand drenching rain after the initial set. The cement is available in 50 lb bags. Baldwin-Hill Co.

Reader Service Cards on pages 117–118 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

3—SELF-STICKING SIGNS help prevent accidents

Self-sticking accident prevention signs are available in three standard sizes — 5 by 14 in., 3½ by 10 in., and 2¼ by 9 in. The signs include both basic purpose signs (Danger) and specific purpose signs (No Smoking). Either can be used alone or in combination with others. Basic purpose signs include, Danger, Caution, Information, Directional, Safety Instruction and Radiation Hazard, in wordings and colors specified by ASA. These signs are made of company's B-500 All-Temperature impregnated cotton with a temperature-resistant pressure-sensitive adhesive. Each sign comes mounted on its own dispenser card — just peel it from card and apply where desired. Bulletin 145-C gives details. W. H. Brady Co.

4—SOLENOID VALVE features noiseless operation

This electro-pneumatic switch is announced as having quiet operation as a particular design feature. Spring, armature, guide tolerances and material specifications are closely held to prevent alternating current hum. When energized, the valve passes full air at supply pressure up to 25 psi. When deenergized, the supply port is stopped and the return line pressure is wasted to atmosphere. A built-in manual adjustment permits valve opening when the coil is deenergized. Port connections are ⅛ in. NPT and 60 cycle coils can be supplied for 115, 208, 230, or 440 v. Electrical leads, 12-in. long, come from a housing which can be rotated to facilitate wiring. Bulletin 359 and Drawing 1255 give more information. The Powers Regulator Co.

5—STEEL CLIP helps to resist condenser tube erosion

Designed to protect condenser tubes from erosion, this stainless steel clip is made from 26-gage metal with slightly flaring sides for tension. It is attached directly to the condenser tube. The clips are available in 2 ft lengths for ¾, ⅞ and 1- in. diam condenser tubes. Use of the clips does not appreciably affect heat transfer rate of the condenser tube, manufacturer states. While the clip does not repair an eroded tube, it resists further erosion and in many cases it may not be necessary to replace the clip-protected tube for a considerable period of time. Occasional inspection of condenser tubes for signs of erosion will determine whether protector clips should be applied. Allis-Chalmers Mfg. Co.

6—INDUSTRIAL INCINERATOR burns refuse outdoors

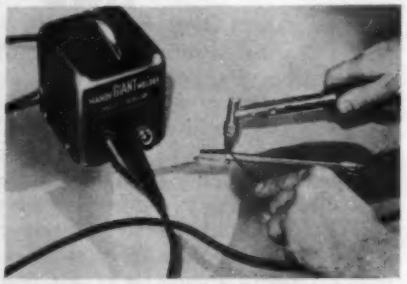
This low-cost, industrial outdoor incinerator has a 12 bushel capacity and is complete with heavy duty grate and ash pan base. The manufacturer states that improved draft control permits burning of damp, green or dry refuse and eliminates the fire hazards of burning, blowing scraps and minimizes smoke and smell. The unit stands approximately 5-ft high and measures 36 in. sq at the base. It is shipped assembled, and weighs 165 lb. The unit is used by lifting off the hood, pouring in up to 12 bushels of refuse at a loading, igniting from the top and replacing the hood. It burns with an intense heat, reducing refuse to fine ash and does not require watching nor any additional fuel. The unit sells for about $69.00. Alsto Co.

7—HOT SPRAY VINYL for economical corrosion control

Formulated to combine ease of handling and good spraying characteristics with optimum build and appearance, this new hot spray vinyl is claimed to provide 4 mils in a single spray pass. One prime and one hot spray coat give the 5- to 6-mil thickness needed in most corrosion protection work, says manufacturer, and vinyl thicknesses in the 10- to 15-mil range without rungs or sags are possible in an uninterrupted multiple pass spray application. It is used with company's universal metal primer, P-50. Prufcoat Laboratories, Inc.

8—WELDING TOOL is light and easily operated

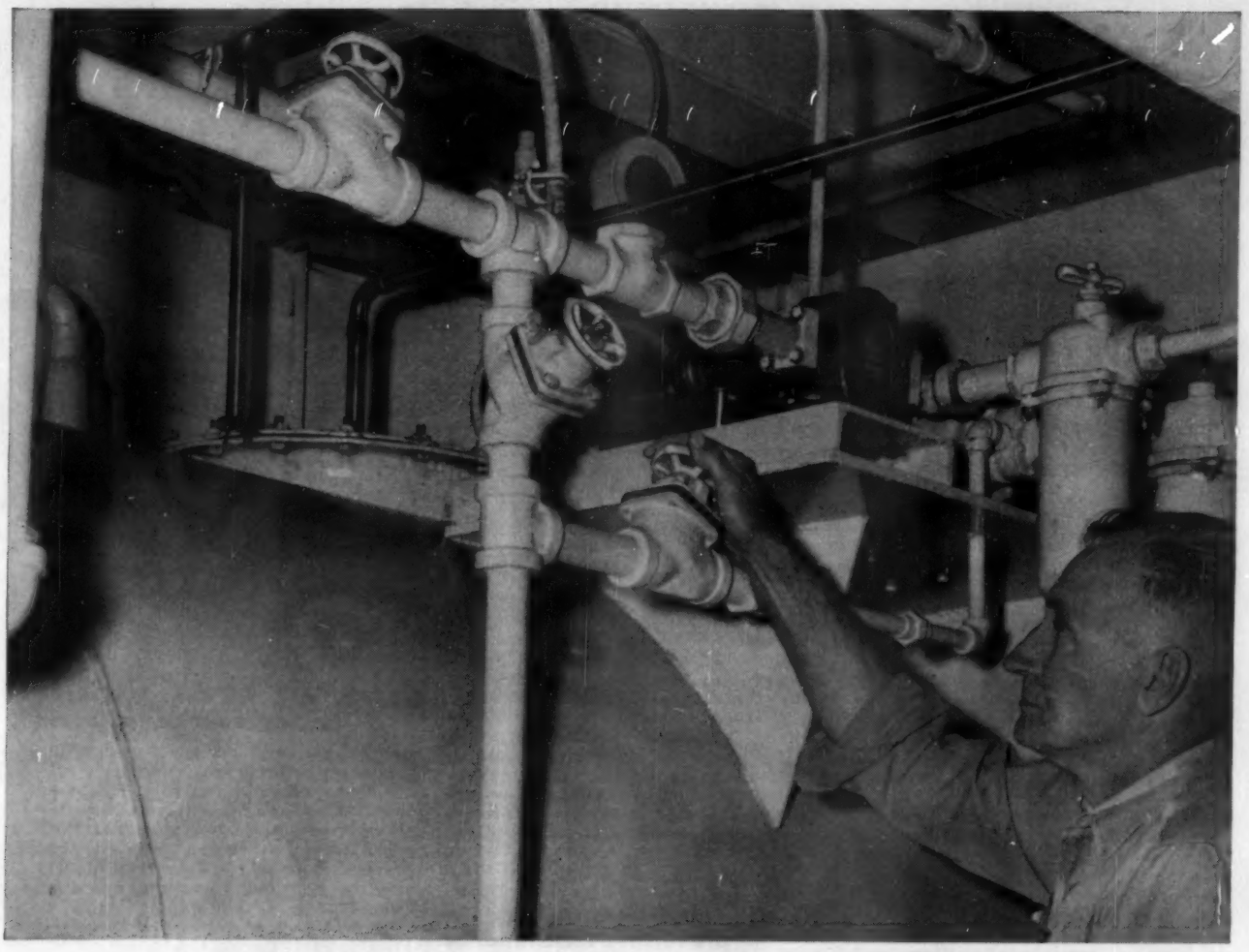
No special skill is required for operation of the Handy-Giant Welder, says manufacturer of this lightweight versatile



tool. It uses only 6 v, operates on 115-v, 60-cycle a-c. According to company it is durable, powerful and safe, and no glasses are required when using it. The tool is suggested for quick welding, brazing, soldering; it may also be used to etch and cut holes in metal. Its shipping weight is 12 lb; it will sell for around $50.00 Cauhorn Mfg. Co.

9—FEED PUMP has horizontally split casing

Type BI boiler feed pump is announced for requirements of high pressure ratings below those of barrel-type pumps. Avail-



Light oil meets its master in these CRANE VALVES

THE CASE HISTORY— Read how the Johnson & Johnson baby products plant at Cranford, N.J., completely stopped a valve leakage condition that wasted product . . . caused a safety hazard . . . and menaced the plant's high sanitation standards.

Valves formerly used on very light baby oil lines were the source of trouble. Keeping them tight at the stuffing box was next to impossible. Constant servicing of stuffing boxes was necessary, even after repacking every 4 to 8 weeks. Several packings were tried without success while the high maintenance costs and nuisance conditions continued.

Early in 1951 the plant found the solution in Crane No. 1610 Packless Diaphragm Valves. They removed the cause of leakage —immediately stopped its troubles and costs. Almost 4 years later—with no maintenance whatsoever—the Crane packless valves remain absolutely tight; continue giving perfect service. And that goes for all valves added since the first installation.

Crane No. 1610 Packless Diaphragm Valves

When you have valve problems with hard-to-hold fluids, try Crane *Packless* diaphragm valves. They eliminate stem leakage and maintenance on air, vacuum, gas, light oil and similar services. Their diaphragm has longer life, yet should it fail, their separate disc prevents escape of line fluid. Available in wide selection of materials and sizes. Ask for folder AD-1942 or see your Crane Representative.

CRANE CO.

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Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

For more data circle 528 on Post Card

able in 6, 8, and 10 stages, the pump is patterned after the barrel type, but it has a horizontally split casing so that the upper half can be removed without disturbing the piping. The capacity range of the three impeller sizes is 225–350, 275–425 and 350–525 gpm. The head per stage is about 280–200, 300–240 or 310–250 ft.

The pump is designed for both radial and axial balance. Radial balance is obtained by alternate up and down arrangement of volutes and axial balance by back-to-back arrangements of impellers. The pump is available with either ring-oiled, water-cooled ball bearings, or sleeve bearings with Kingsbury thrust, ring oiled and pressure lubricated by oil pump. Its deep stuffing boxes are arranged for water cooling from an external source. Allis-Chalmers Mfg. Co.

10—CIRCUIT BREAKER, 400 amp, is "intermediate" size

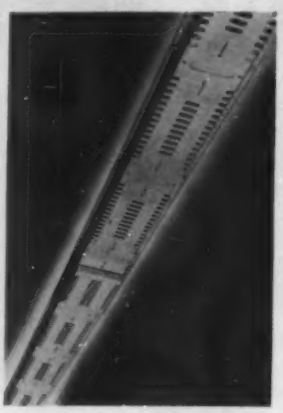
The KL, a 400-amp molded-case air circuit breaker, is introduced to fill the need for frames intermediate in size between manufacturer's older K and L frames. Highly compact, the KL breaker is 6 in. shorter than the L breaker previously necessary for 400-amp applications, and only ½ in. longer than K breakers. Providing automatic circuit protection for enclosures, switchboards and panelboards, the breakers employ both thermal and adjustable magnetic tripping for overload and short circuit protection. Their interrupting capacity is 25,000 amp at 600 v a-c, or 30,000 amp at 240 v a-c. Available ratings range between 125 and 400 amp at 600 v a-c or 250 v d-c. Two- and three-pole units are identical in size and are suitable for front and rear connection. Features include De-ion arc extinction, silver alloy butt contacts with quick-make, quick-break action, and interchangeable trip units. Accessory features such as shunt trips and remote control operation are available. Westinghouse Electric Corp.

11—TOOL ATTACHMENT for use with portable electric drills

Hefty Holer, a heavy duty tool attachment for portable electric drills, is reported to fit any electric drill; it weighs only 1¾ lb. According to manufacturer, it will saw wood, plastic or plasterboard and cuts all metals in pipe, bar, tube, rod, or sheet form without a starting hole. Hefty Holer will nibble metal lath, wood, plastic composition material or sheet metal up to 20 gage, reports state, with only a ¼ in. starting hole. It sells for about $20.00. Accessory tools available include files, chisels, gouges, and jig saw blades. Little Beaver Industries, Inc.

12—BUSWAY SYSTEM, improved, low-voltage type

Uni-Bus is announced as a new development in low voltage feeder and plug-in busway systems. Available in ratings from 225 to 775 amp, 600 v, two-, three-, and four-pole types, the Uni-Bus System



features a single size ventilated steel enclosure accommodating all current carrying capacities. Construction details are identical for both feeder and plug-in types; a duo-circuit arrangement offers low reactance characteristics for both. Weight savings up to 40 per cent are claimed, and either horizontal or vertical installations are possible. According to company, the Uni-Bus plug may be isolated from bus by safety slide and utilization circuit is energized through primary and secondary contacts in the plug. Roller-Smith Corp.

13—THREAD COMPOUND aids in preventive maintenance

Fel-Pro C-5 "Hi-Temp" Thread Compound is announced for stainless steel and high temperature applications up to 1800 F. Company reports it is now being used to prevent galling and seizing studs, bolts and threaded assemblies, and as a preventive for galvanic pitting of stainless steel. C-5 is formulated on a special colloidal-copper base in a non-volatile and viscous carrier. In effect, C-5 "copperplates" metal to prevent direct contact. It is non-corrosive, its formulation prevents galvanic pitting of stainless steel at all temperatures, company says, and is especially effective where dissimilar metals of the latest alloys are joined. The use of C-5 in protecting threaded surfaces is said to minimize shut-down or dismantling time, and prevent costly stud breakage. Felt Products Mfg. Co.

14—FILTER CARTRIDGE has extra large filter area

Available in Types F-718 and FW-718, this filter cartridge is announced as having a tremendous filtering area, low pressure drop and high dirt storage capacity. The two types are similar in construction but permit different methods of installation. The density of filter paper used in the cartridges results in removal of particle sizes down to 5 microns. The degree of initial particle size removal can be controlled by use of special papers and other materials where conditions require such control. Being made of cellulose these cartridges are suitable for filtering straight mineral oil or heavy duty detergent oils without removing detergents, oxidation inhibitors. Purifier Div., The Hilliard Corp.

15—ZEOLITE BYPASS controls the degree of hardness

This zeolite bypass serves to control the proportionate mixing of untreated hard water and treated, fully-softened water to produce whatever degree of hardness desired. Operation is described as simple. A single setting (on the adjustable orifice) regulates the ratio of hard to soft water, it is noted; the valves are automatic and adjust to flow variations of one to four, without perceptible loss of accuracy. There are no pumps and few moving parts. This simplicity keeps costs down for installation, operation and maintenance, manufacturer points out, and assures dependability. Bypassing the Zeolite softener is said to extend softening cycles and produce savings in operation and resin costs. The bypass may be applied in controlled-scale corrosion prevention; municipal water supply; and wherever it is preferable to use simple zeolite softening without producing a zero-hardness water. Graver Water Conditioning Co.

16—RUBBER REPAIR MATERIAL for conveyor belts, cables

Rema is announced as a self-vulcanizing rubber repair material for repairing rubber conveyor belts and rubber covered electrical cable. It is explained that the abrasive-resistant cover stock and rubber filler self-vulcanize by a chemical process. Repairs can be made quickly and the belt put back into operation immediately, says company, and no heat or heavy equipment is necessary. Flexible Steel Lacing Co.

17—HOODED COVERALL for boiler maintenance jobs

Designed to protect almost the entire body of the wearer, this hooded coverall

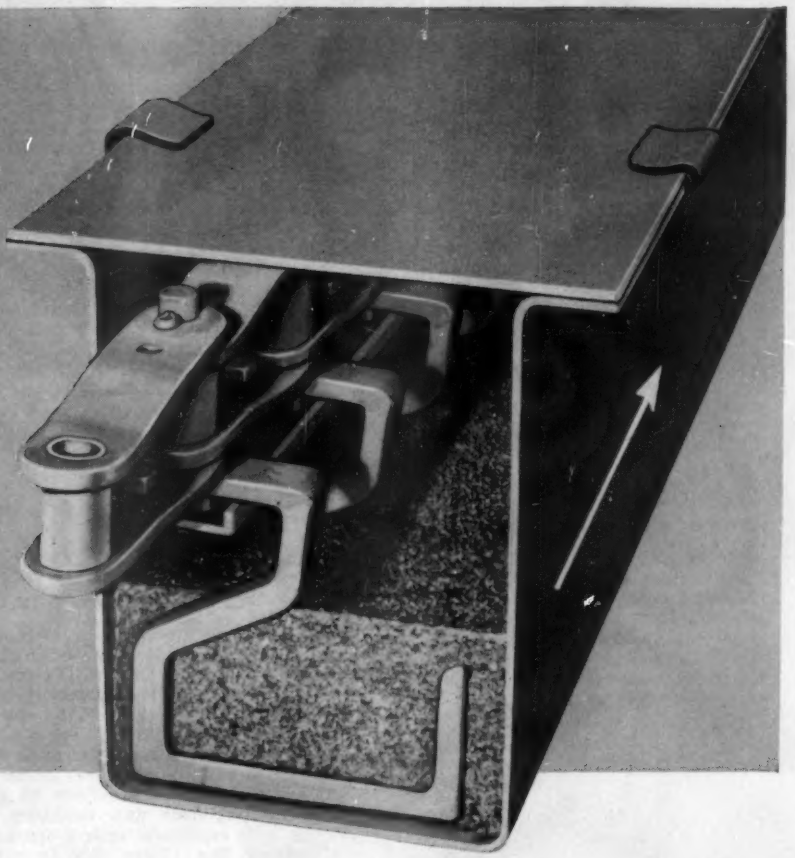
fastens tightly at the ankles and wrists and is self-adjusting to offer the greatest possible protection against dirt, soot and grime. Boot straps keep the legs from riding up, and the hood, with tie strings, fits snugly around the face. With the wearing of goggles, little facial area is exposed. Made of heavy blue washable denim, this boiler maintenance uniform has double knees and elbows and a buttoned-on, reinforced front-piece to withstand crawling. This coverall will be available for less than $7.00. M. Setlow & Son, Inc.

18—METALLIC PUTTY hardens by chemical action

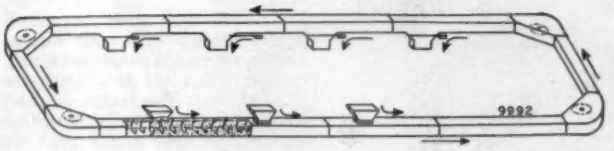
Metalset A201, a versatile aluminum putty, which shrinks less than 0.2 of 1 per cent while hardening, and will not crack in thick applications, is an-

CONVEYS ANYTHING Economically from COAL to CORNSTARCH

with simultaneous pick-up or discharge at one or many points . . . without dust or contamination . . . in small space



This is an S-A REDLER Horizontal Closed Circuit Conveyor — and a very remarkable unit it is!



It conveys in four directions — can pick up and discharge at many points on its run simultaneously or selectively—does the work of several conveyors of other types. It is fully enclosed — dust-tight and contamination-proof. Because it moves materials *in mass,* in a solid column, it minimizes dust formation and degradation and practically eliminates explosion hazards.

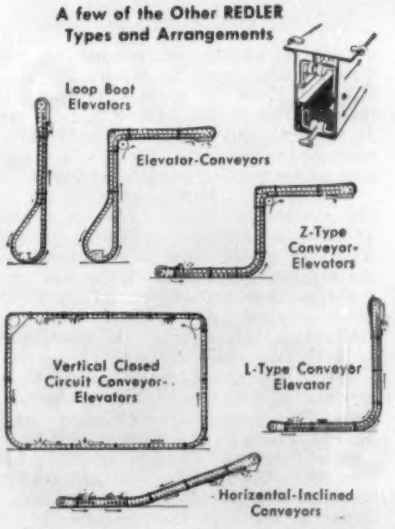
It is self-feeding and can be choke fed without jamming. Any excess material simply recirculates until needed. The REDLER is also self-cleaning, an important advantage when the operation calls for running various materials in sequence. It makes an ideal blending conveyor.

Unusually compact, REDLERS require a minimum of structural support. They can be easily and economically adapted to practically any plant layout.

The closed circuit REDLER is just one of many types furnished by S-A. If you handle or work with any kind of granular, pulverized, flaky or small lump material, a REDLER can help you do it better, cleaner and at lower cost.

Write for Catalog No. 140. We'll be glad to give you a preliminary cost estimate. No obligation, of course.

A few of the Other REDLER Types and Arrangements



SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

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Engineering Division
Specialists in the design and manufacture of all types of bulk materials conveying systems.

Standard Products Division
A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

Sealmaster Division
A complete line of industrial ball bearing units available in both standard and special housings.

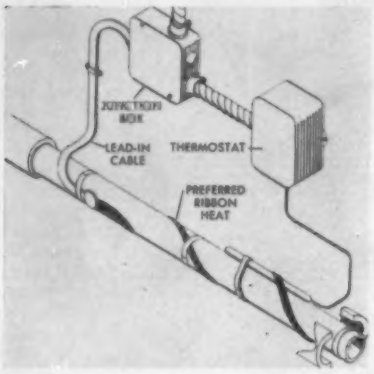
For more data circle 529 on Post Card

nounced for building up metal surfaces or for caulking seams and holes in metal and wood surfaces. Though easy to mix with its curing agent, the putty is said to have the needed thixotropy for application with simple hand tools to vertical and overhead surfaces. It hardens to a metallic density at room temperature, and curing can be speeded with additional external heat. Manufacturer says this product can be machined by conventional methods, can be tapped or drilled; it is not affected by water and resists acids and alkalis.

Metalset A201 is epoxy resin compounded with aluminum and other ingredients to form a paste. Heat ceiling is 300 F. Its chemical and dimensional stability let it be used for outdoor metal surfaces. Smooth-On Mfg. Co.

19—HEATING TAPE keeps oil lines at pumpable temperatures

Preferred Ribbon Heat is said to offer a convenient and inexpensive means for electric heating of suction lines carrying residual (No. 6) oil from fuel tank to pump and heater. Its purpose is to keep the oil in the lines at pumpable temperature, especially during burner shutdowns or out-of-service periods, by making



up the radiation, convection or conduction losses from the piping. Preferred Ribbon Heat is a low temperature lineal heater in the form of flexible tape ½ in. wide and 1/10 in. thick, of fusible alloy resistance wires, braided, insulated, and protected for continuous use.

The tape is spiralled directly around the suction piping. It can be applied to new or existing oil piping systems. The end of the tape is attached by a waterproof connection to a 3-ft nonmetallic sheathed cable, thence to the electric supply. A thermostatic sensitive bulb, strapped against the pipe, leads to a thermostatic control. The cable is directly connected into a standard electric outlet box. Use of this tape is based on maintaining a pipe line temperature at 100 or 120 F. Selection of unit length depends on the voltage and the heat loss from the pipe surface and through the pipe line insulation, with the current input to the tape thermostatically controlled. Preferred Utilities Mfg. Corp.

20—CONDUIT FITTINGS for use in hazardous areas

By sealing vertical runs of conduits, this explosion-proof drain sealing conduit fitting, the Type EYD, guards against insulation failure by water accumulation. Similar in function to company's Type EZD Sealing Condulets, but without the removable inspection cover, the fitting is more economical to use and available in larger hub sizes. Hubs range from ½ to 6 in. in two styles: the smallest sizes have one opening for damming and filling, and those of 1¼ in. and larger have separate damming and filling openings. To drain water continuously, this fitting has an ECD drain.

It is noted that since a length of rubber tubing and solid copper wire are furnished with each conduit fitting, damming and filling the seal interior are done more simply. The tubing, with the wire inside, is inserted up through the drain opening into the sealing chamber. Sealing compound is poured in, enclosing all but the top of the tubing. After the compound is hardened, the wire and flexible rubber core are removed, leaving a drain path from the seal's upper surface to the drain. Crouse-Hinds Co.

21—EXPLOSION-PROOF MOTOR in NEMA sizes, 1 to 5 hp

Announced as meeting the strict specifications of the National Board of Fire Underwriters, the Type E Motor is designed to operate in dangerous locales and is made for Class I, Group D services for highly inflammable gases and volatile liquids, and Class II, Groups F and G for combustible dusts. It is fully enclosed, with special provision to guard against fire, dust and moisture. The Type E is equipped with a sparkproof aluminum fan (Type EN is without fan).

The conduit box is sealed and of heavy design with split dome. Internal bearing caps are extended along the shaft to insure against any spark traveling to the exterior. The frame is one-piece cast iron with external ribs for reinforcement and to provide rapid heat dissipation. The Types E and EN Motors embody asbestos-protected windings, Lubriflush lubrication and normalized castings. Bulletin 1879 describes these motors. U. S. Electrical Motors Inc.

22—CONTROL DEVICE serves to initiate action

An automatic, all-electrical device for initiating action when a predetermined value is reached, this control initiating instrument is announced for installation on switchboards or panel instruments. In operation, the system electrically picks up signal from the instrument pointer which eliminates disadvantages of mechanical contacts, according to company engineers. Because control of

important variables is automatic, human errors and expenses are reduced. Typical applications include: sounding an alarm when the controlled temperature reaches a critical value; initiating control to contain cycles per sec within a specified range; shutting down equipment at a maximum vibration point; and shutting down machinery drawing more than normal power. The control is suitable for one-set point or two-set point initiation. The load relay supplied is rated at 120/240 v, 10/5 amp, single pole double throw. General Electric Co.

Described on these pages are new and improved products. Use Reader Service Cards on pages 117–118 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

23—PORTABLE VISE STAND can double as a work bench

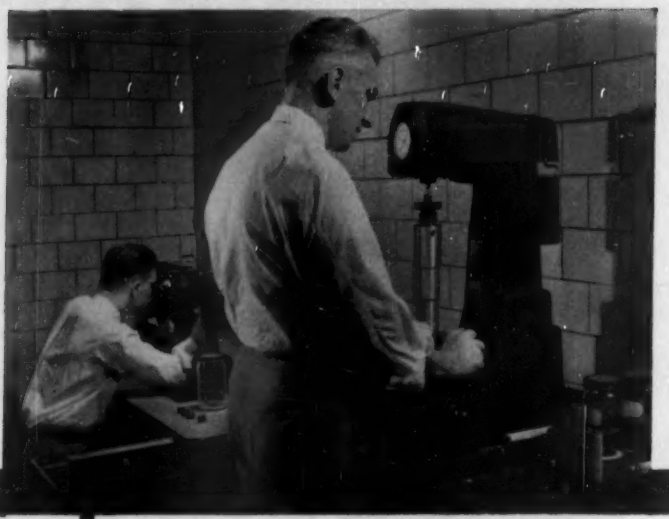
This portable vise stand is reported to have features that make it an efficient on-the-job work bench for the pipe fitter. The stand sets up or takes down

in a jiffy, as it is all in one unit with no loose parts. The built-in tray pushes up and folds for easy carrying and compactness, requires less space on the truck or if stored between jobs. Though extra light in weight for portability, vise stand is sturdy and won't fold up in use. Other features include: large size vise base for easy mounting; three pipe benders; plenty of tool slots; pipe rest and ceiling brace. Toledo Pipe Threading Machine Co.

24—VARIABLE CAVITY PUMP maintains constant flow

Maintaining a constant volume of flow despite fluctuations in city water pressure is the function of this variable cavity pump. When the pressure in the pump reaches a predetermined point, a spring-loaded end plate moves outward, increasing the length of the pump cavity and enlarging the clearances between the ends of the rotor and the end plate. Increased clearance in the pump lets the liquid recirculate, reducing the pump's maximum pressure. Pressures can be varied from 3 or 4 lb up to 75 lb, manufacturer states, and when they drop the end plate is automatically

Heat-treating and physical testing equipment shown at left is used for quality control of welding operators and for development of new welding procedures.



This Rockwell hardness testing machine measures the hardness of weld specimens as a guide to proper procedures for heat-treating of welds.

Daily rigid testing is your insurance of quality welds in

NAVCO FABRICATED PIPING

At Navco, a continuous parade of weld specimens are processed in the new, modern physical-chemical testing laboratory. It is here that weldments are studied metallographically and tested physically—all on a rigid schedule of quality control practices. Navco customers have benefited from progressive quality control practices for more than 40 years; they have come to know that piping installations, engineered, fabricated and erected by Navco, are precise, accurate and dependable.

Call on NAVCO for your next piping job.

A laboratory technician cuts a sample from a pipe weld prior to grinding and polishing for metallographic examination.

Here a weld specimen is etched to outline the grain structure for further metallographic study.

NATIONAL VALVE & MANUFACTURING COMPANY

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DARTS ARE THRIFTY ON THE POCKETBOOK

. . . TIGHT ON THE LINE!

Yes sir, Dart Unions cut costs because

1. They last longer — their two bronze seats are precision ground to a true ball joint.
2. They're easy and fast to install.
3. They *stay* tight — damage no property, spoil no work.
4. They can be used over and over again.

Which is why the answer to "How thrifty, how tight *can you get* is . . . GET DARTS"!

QUICK FACTS

- Leakproof because precision-machined to a true ball joint and spherically ground
- Shoulders are heavy — can take abuse
- Each Dart is individually vacuum-tested
- Bronze alloy seats are extra wide, resist pitting and corrosion
- Practically indestructible nut and body — of air-refined, high-test malleable iron

DART UNION COMPANY
Providence 5, Rhode Island
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DART UNIONS

CALL YOUR LOCAL DISTRIBUTOR FOR PROMPT DELIVERY OF DART UNIONS

For more data circle 531 on Post Card

forced in by springs to reduce clearances.

Pump parts are available with ⅜-in. internal pipe thread or external garden hose thread. The hollow shaft pump will slip directly onto a ½-in. motor shaft. Maximum expansion of the pump cavity at 75 lb pressure is 0.005 in. — at 30 lb, 0.015 in. The end plate serves as a relief valve; it operates like a piston. Hypro Engineering, Inc.

25—A-C MOTORS protected against drip, splash,

Total protection is claimed for this new line of a-c motors which incorporate such features as solid-cast frames and plastic sleeving for the brazed coil head connections in the insulated "heart" of the motor. Ventilation louvers of the motors are positioned in the end brackets. The frame extends beyond the coil heads to protect windings, and compact brackets are designed to afford shaft support by placing the bearing mountings closer to the frame. According to company these motors offer complete protection against drip, splash, and falling objects — regardless of mounting position. Included in this group of enclosed a-c motors are fan-cooled, corrosion-proof and explosion proof designs. Reliance Electric & Engineering Co.

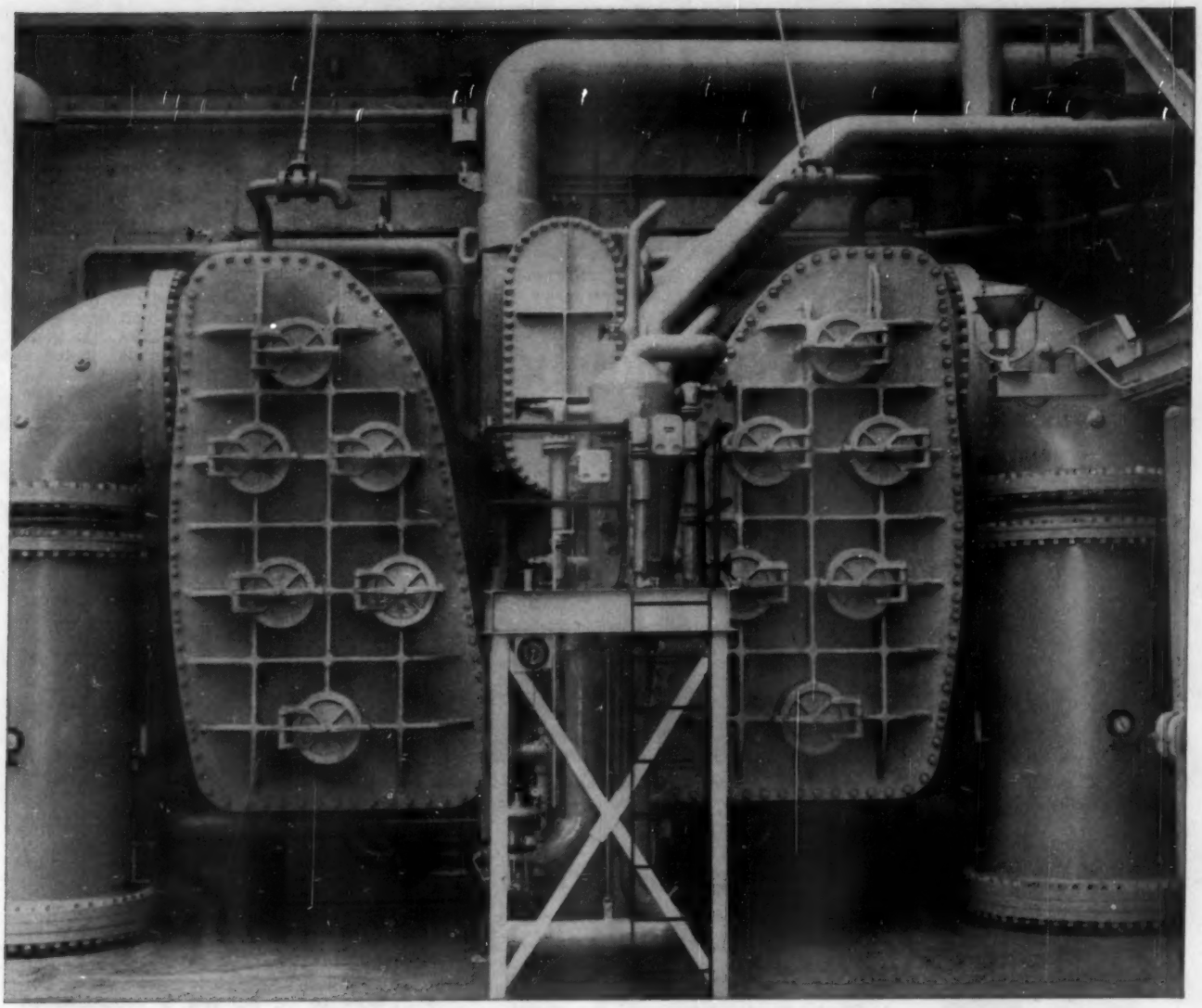
26—AMMONIA CONDENSER is evaporative unit

Basic principle of this 200-ton refrigeration capacity ammonia condenser is that of evaporating sprayed water from the surface of condensing coils through which the refrigerant gas passes, extracting heat at the rate of 1000 Btu per lb of water evaporated. The air stream enters at the top of the condensing section, is drawn downward through the water sprays, over the condensing coils, and then turns upward to leave the unit through propeller-type fans at the top. This reverse direction air stream is a departure from previous practice, it is noted; it increases capacity of the unit and reduces the outlay for electric power. The spray water falls into a tank at the base of the unit, from which it is recirculated, with a net water consumption said to be less than 5 per cent of the water used by many condensers of equal capacity.

In addition, the unit is equipped with company's Duo-Pass precooling coil which removes the superheat from refrigerant gas, making it close to condensing temperature before it enters the sprayed, condensing section. This is designed to avoid the precipitation of scale deposits. Also, in the gas line, between precooler and condensing coil, is located the "Oil-Out." At this point the oil vapor is condensed and is easily removed from the refrigerant. The Niagara Blower Co.

27—A-C WELDER for general maintenance work

This general purpose a-c welder is announced for job shops and light industrial applications. Covering a current range of 25 to 295 amp, the low-priced welder is suggested for maintenance work, tack welding at high currents, and steady welding at moderate currents. It provides a 50 per cent duty cycle in the normal welding range of 200 amp, with somewhat lower duty



four FW condensers serve

PG & E's NEW PITTSBURG PLANT

COMPLETELY modern in every detail of design and equipment, the Pacific Gas and Electric Company's new 660,000 kw plant at Pittsburg, California, is the largest steam power plant west of the Mississippi.

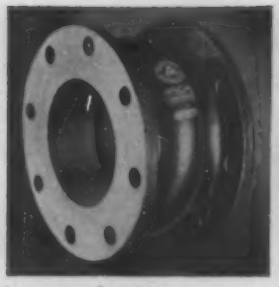
Each of the 165,000 kw turbines is served by a Foster Wheeler Cross Flow type, single-pass condenser as shown above. With 65,000 sq. ft. of condensing surface, each of these four FW units has a rated condensing capacity of 726,000 lb of steam per hour, with a turbine exhaust pressure of 1.3" hg absolute and 98,600 gpm of circulating water at 60 F.

A space-saving feature of this condenser design is the location of the FW low-pressure heaters in the intake passage between the cross-flow tube banks. This heater arrangement can be seen in the center of the photograph above.

With this latest installation, PG&E has purchased a total of 14 large condensers from Foster Wheeler in the last 10 years. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

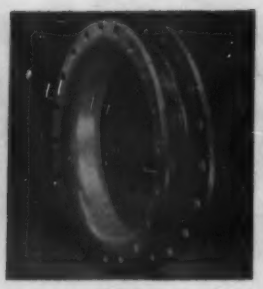
FOSTER WHEELER

For more data circle 532 on Post Card



Spool-type
Rubber Expansion Joint

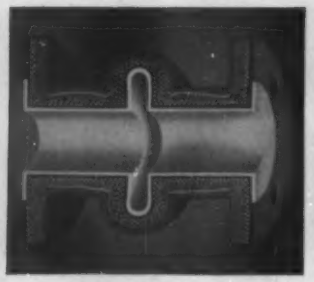
Rectangular-type
Rubber Expansion Joint



U-type
Rubber Expansion Joint

There's a GARLOCK EXPANSION JOINT for your piping applications

All-Teflon*
Expansion Joint



Rubber Expansion Joint
with Teflon liner

Expansion Joint for use on
Haveg and Duriron piping

- **To stop vibration, flange breakage**
- **To relieve stresses and strains in piping and equipment**

Garlock manufactures a *complete* line of expansion joints specifically designed to meet the requirements of different types of service. **Rubber Expansion Joints** are made in all pipe sizes from ¾" to 72" for water, air, or exhaust steam. They are furnished in round, rectangular, tapered or offset; spool-type and U-type.

All "Teflon" Joints or **Rubber Joints with Teflon liner** are made for chemical service; **Neoprene Joints** for oil service. Specially designed Rubber Expansion Joints are now available for use on piping and flanges made by **Haveg Corp.** and **The Duriron Co., Inc.**

Write today for Expansion Joint Folder AD-137.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo Chicago • Cincinnati • Cleveland • Denver • Detroit • Houston Los Angeles • New Orleans • New York City • Palmyra (N.Y.) Philadelphia • Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

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GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS, RUBBER EXPANSION JOINTS

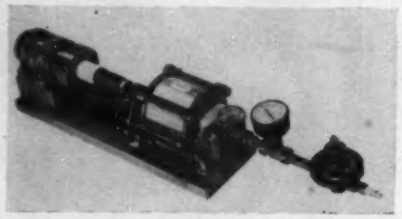
For more data circle 533 on Post Card

cycles when higher settings are used. A low range open circuit voltage of 75 v provides easier starting and facilitates use of low hydrogen and stainless steel electrodes. Good performance is also claimed at high current settings, where a 65 v OCV is supplied. Utilizing the moving primary coil design, the welder is designed to provide pin-point accuracy of current settings and resettings throughout the entire current range.

To simplify routine maintenance and primary connections, side covers may be removed by taking out three screws on each side. The welder includes a dual position range switch, fingertip current adjustment, and bolt-type output terminals. Type WK29A, the general purpose and shop model, includes a 230 v primary circuit with steel-tired castors as standard equipment. For heavier applications, Type WK29L includes a 230–460 reconnectable primary circuit. General Electric Co.

28—PROPORTIONING PUMP
Features positive control

Designed for use in metering and proportioning of small volume flows, the UP Pump uses a double acting air cylinder to provide quick starts and positive stops at high or low speeds. It utilizes the same liquid end components as company's series UM Pumps except



that plant air supplants a motor drive. With it, air is alternately admitted to and exhausted from a double acting air cylinder through a four-way valve. Volume to be pumped is controlled by stroke length adjustment; and/or by controlling air supply pressure or speed of actuating the valve.

The pump can be applied in proportioning of petroleum inhibitors and additives, odorants to natural gas and food industry uses. It is available in stainless steel, Hastelloy, Monel and plastic. Outstanding features announced are: positive control over flow for quick, accurate starts and positive stops, unit mounting of drive and pump body on common base, interchangeable parts, compact, easy to clean check valves. The pump can be furnished with necessary components for a complete liquid feed system. Bulletin UP-55 gives details. Hills-McCanna Co.

29—THERMOPILOT RELAY for shut-off of gas fired units

Automatic reset and stable operation are features announced for the A-100R Thermopilot Relay for automatic safety shut-off. Any tendency to chatter because of vibration is claimed to be eliminated by a pilot generator which supplies 10 times the voltage of many single thermocouples of the same physical size. Current generated by this pilot generator closes the electrical relay switch. It is explained that when the pilot flame is extinguished, or an unsafe low pilot condition exists, the relay

TRY ONE IN THE LINE AND YOU'LL SEE WHY

Specifying Hancock Bronze Valves means big savings in your valve investment

The economy of Hancock "500 Brinell" Bronze Valves has been proved by industry . . . in piping systems similar to yours. Users rate them No. 1 because Hancock Bronze Valves are built with quality materials and design features that save money on valve investment. Put one in the line and the demonstrated savings will lead you to specify Hancocks from then on.

Here's why they cut costs! Seat and disc are superhard "500 Brinell" stainless steel, formed for tight bottom seating under compression, without tension. No leaks! No wire drawing, galling, steam cutting! The rugged diaphragm is 125 to 230% stronger than in the usual bronze valve. Long-wearing silicon bronze is machined into a large diameter stem with Acme thread to assure straight-line rigidity and smooth operation. A practical back-seating design makes it easy to pack the Hancock Bronze Valve under pressure.

When Hancocks go in, valve costs go down.

HANCOCK
"500 BRINELL"
BRONZE VALVES

Globe, Angle and Check
150#, 200#, 300#

Sizes: ¼" Thru 2"

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR of premium-quality Hancock Bronze Valves will gladly help you pick the right valve to produce maximum savings, or write for Bulletin 260.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn.* and *Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

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EXACT CONTROL of Moisture Content

. . . To Improve Your Product or Protect Your Materials or for Processes or Tests

● This Niagara Air Conditioning Method dries air directly and measurably, using a moisture-absorbing liquid spray. It makes humidity control a separate function from lowering or raising temperatures and gives you precise control with thermostats alone; no moisture-sensitive devices are needed. You have simpler, more trustworthy, less expensive control instrumentation. Niagara precise-control installations have the best record for reliability.

Niagara Air Conditioning provides you with any temperature and relative humidity you need. Using "Hygrol" absorbent, it is not expensive to operate, saving the refrigeration commonly used to condense moisture and making re-heat unnecessary in most cases. It gives large capacity with compact, easily-maintained equipment. Ask for Descriptive Bulletins #112 and #121. Address Dept. E.

NIAGARA BLOWER COMPANY

405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada

For more data circle 535 on Post Card

breaks contact to shut off the main control valve. When the unsafe condition is corrected, relay contact is automatic, says manufacturer; no manual reset is required and a slight variation in pilot flame does not result in a false drop out.

The relay is available with either two- or three-wire connections. The former, with relay normally open is for pilot flame safety on furances, ovens, boilers and similar gas-fired equipment. The three-wire units, with their single-pole, double-throw action, can be used in alarm circuits and in electric ignition circuits. General Controls Co.

30—MULTI-POINT INDICATOR with manual switching

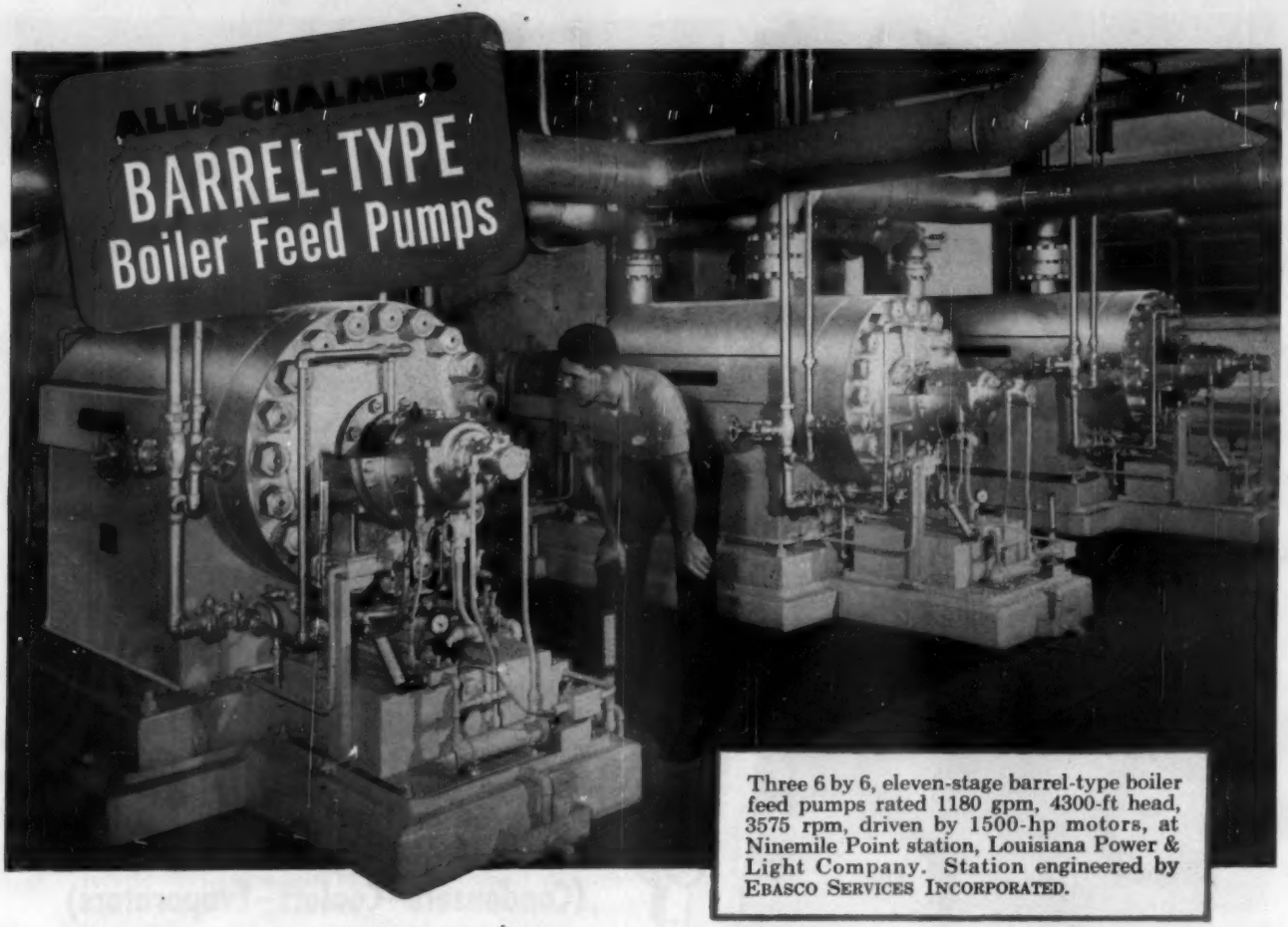
Designed to scan a number of process variables by use of a manual switching arrangement on front panel, the Type HJ Precision Indicator may be used with provision for measuring up to 48 circuits, or in conjunction with a multi-point strip-chart recorder to obtain an intermittent record. According to company engineers, the instrument incorporates a magnetic standard to provide

continuous measurement and standardization. Utilizing this circuit is claimed to eliminate maintenance and replacement associated with dry cells, standard cells, and slide wires. It also allows operation in ambient temperatures from zero to 125 F.

The use of plug-in components — range resistor, reference junction oven, and tubes — combined with standard-unmatched tubes helps make the instrument easy to service. Indicator is available in two basic types, d-c potentiometer or a-c bridge, and it can be provided as a single-point or multiple-point instrument. The scale is concentric and rotating, 32¾ in. in length. Response time for full-scale travel is optionally 4 or 12 sec or 60-cycle operation. General Electric Co.

31—MECHANICAL PACKING for liquid caustics

Designed exclusively for liquid caustics, White-Lon Style 322 Mechanical Packing is claimed to be ideal for use on stainless steel or chrome plated pump shafts to form a tight seal against such strong alkalies as sodium, potassium, barium, ammonium or magnesium hydrozides. A method of treating individual strands of pure Chrysolite Canadian asbestos with a Teflon Suspensoid is used to immunize the packing against alkalies and prevents seizing or scoring of shafts. A. W. Chesterton Co.



Three 6 by 6, eleven-stage barrel-type boiler feed pumps rated 1180 gpm, 4300-ft head, 3575 rpm, driven by 1500-hp motors, at Ninemile Point station, Louisiana Power & Light Company. Station engineered by EBASCO SERVICES INCORPORATED.

First Choice with Louisiana Power & Light Company

A proved service record the country over . . . simple, low maintenance design . . . high efficiency performance — these were some of the factors that led Louisiana Power & Light Company to choose Allis-Chalmers barrel-type boiler feed pumps for their Ninemile Point station.

Features Keep Operating Costs Low

First stage has twin, single-suction impellers to give low NPSH requirement for highest efficiency under fluctuating loads. Impellers, mounted back to back, balance axial forces without use of balancing drum. Double volute casing maintains radial balance under fluctuating load. Expansion joint and shaft seals are brought to outside of pump where they may be inspected often and worked on easily, if required.

Complete Unit From One Source

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 08B7899.

A-4635

ALLIS-CHALMERS

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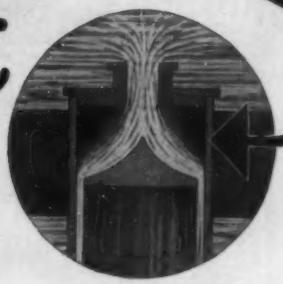
Dirty Water can't "Shut-down"...

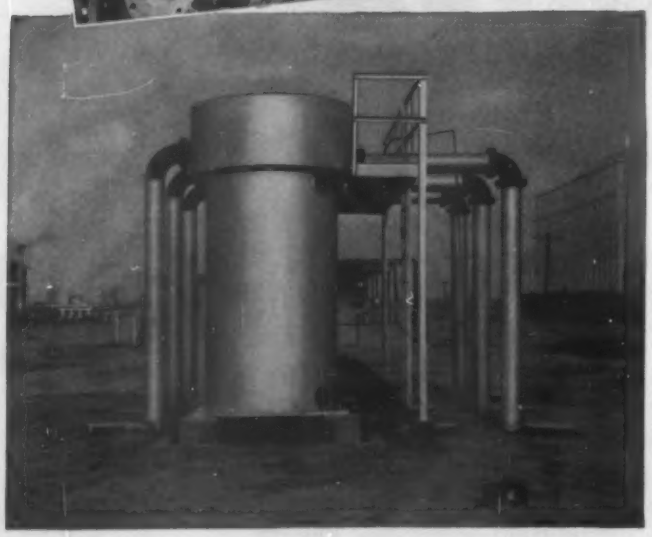
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

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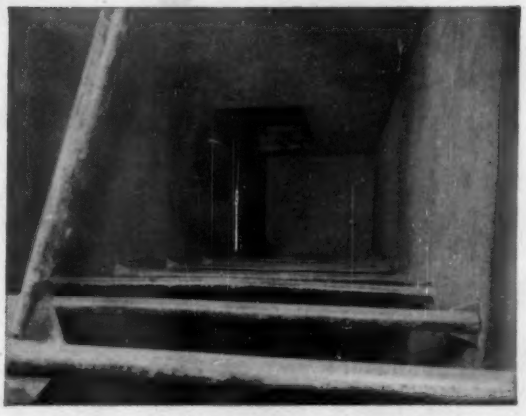
5½" of TOUGH REFRACTORY CONCRETE will top this boiler floor. Cement gun application of a castable refractory mix speeds installation . . . cuts downtime.

DURABLE INDUSTRIAL CONCRETE LINING of this giant multiclone ash precipitator is made with Lumnite calcium-aluminate cement and selected aggregates.



MANY PROBLEMS OF HEAT, corrosion and abrasion are easily solved with Lumnite cement linings. This hot-air duct features a smooth, jointless lining made with a castable.

HEAT-RESISTANT CONCRETE MADE WITH LUMNITE resists heat, abrasion and thermal shock in this ash hopper. Easy-to-place Heat-Resistant Concrete is ready for use within 24 hours.

SPECIAL LUMNITE* INDUSTRIAL CONCRETES—

READY FOR ACTION

. . . *in less than a day!*

Special concretes made with Lumnite cement reach service strength within 24 hours . . . stand up under high-temperature service . . . last year after year!

Save dollars and days on your next construction or repair job by using concretes made with Lumnite. These Special Concretes are highly *adaptable!* . . . easily placed in any size or shape, for linings or structural members — by pouring, troweling or cement gun. They resist heat, corrosion, abrasion and thermal shock . . . give long, trouble-free service.

Refractory Concrete for service up to 2600°F. is one of the many ways the special advantages of Lumnite Industrial Concretes can be used. For convenience you can make Refractory Concrete with a prepared castable mix — just add water to a packaged castable, mix, and you're ready to place Refractory Concrete. In 24 hours or less your job will be ready for service.

Castable refractories provide the right combination of selected aggregates and Lumnite calcium-aluminate cement carefully proportioned to meet the heat-resistance and insulation requirements of many jobs. They are made and distributed by manufacturers of refractories. Keep a few bags on hand to speed your next emergency repair.

For more information write Lumnite Bureau, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

OFFICES: *Albany, Birmingham, Boston, Chicago, Dayton, Kansas City, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, Waco.*

**"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

PE-L-105

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

UNITED STATES STEEL HOUR—Televised alternate weeks—See your newspaper for time and station

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SAVE MONEY AND PROTECT YOUR PLANT BY

Installing Hancock 1500# and 2500# Steel Valves and assuring dependable leak-proof service

Put an end to the costly hazards of valve leakage in your high-pressure, high-temperature steam plant! Let proved-in-the-line Hancock 1500# and 2500# Valves assure the safe, reliable performance so essential to protect personnel, plant and service to customers.

Hancock 1500# and 2500# Steel Valves are preferred by most design and operating engineers in modern steam plants for very practical reasons. There is no bonnet joint to leak, no gasket to leak, no seat insert to leak! In fact, these rugged valves have every design, quality and construction feature essential for the severest services. Get complete information, then try one of these heavy-duty valves. You will soon agree that . . .

When Hancocks go in, valve costs go down!

SIZES:

¼" through 2" Outside Screw and Yoke

SERVICE RATINGS:

Screwed and Socket Weld Ends: For all pressures up to 2500 psi at 1050° F., O.W.G. 6000 psi—100° F.

Flanged Ends: For all pressures up to 1500 psi at 900° F., O.W.G. 3600 psi—100° F.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is as close as your telephone. You can depend on his recommendations and service to save you time, trouble and expense.

In Canada: *Manning, Maxwell & Moore of Canada Ltd., Galt, Ontario*

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, Stratford, Conn. 'CONSOLIDATED' SAFETY RELIEF VALVES, Tulsa, Okla. AIRCRAFT CONTROL PRODUCTS, Danbury, Conn. and Inglewood, Calif. "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, Muskegon, Mich.

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3:59.4 or 4:01.4

There's enough difference To make all the difference

A difference of only 2 seconds . . . but it made sports history on May 6, 1954, when the first under-four-minute mile was run in Oxford, England.

The differences in quality and performance that Scovill builds into its Heat Exchanger Tube, while they also may seem small, can make a *big* difference in improving your operating record. Scovill Phosphorized Admiralty Heat Exchanger Tube, for example, begins its long service life with an added advantage. It is initially hot-extruded from billets *continuous-cast* by Scovill's pioneer process. This means sounder metal — smooth, dense, free from pits or porosity. It means new uniformity of chemical composition, with optimum and uniformly distributed phosphorus content.

The next time you have a new installation or a re-tubing job, let us show you how these differences in Scovill Heat Exchanger Tube work for you.

Scovill Manufacturing Company, Mill Products Division, 99 Mill Street, Waterbury 20, Connecticut. Phone PLaza 4-1171.

SCOVILL **HEAT EXCHANGER TUBE**

Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Muntz Metal • Naval Brass • Red Brass, 85% • Deoxidized Copper
Arsenical Copper • Copper Nickel, 10% & 20% • Cupro Nickel, 30% • Aluminum Brass • Aluminum Bronze, 5% • Duplex Tube

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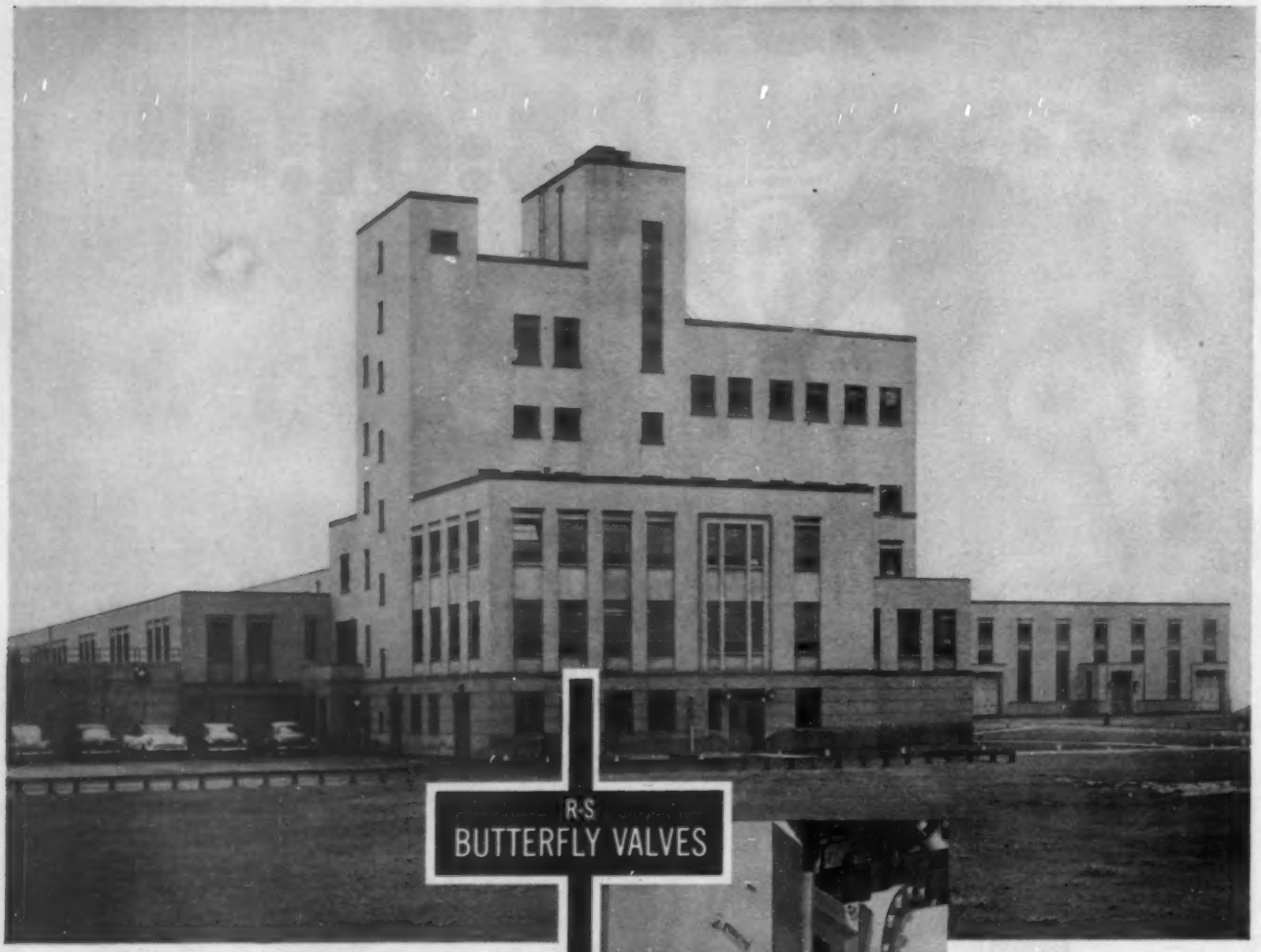

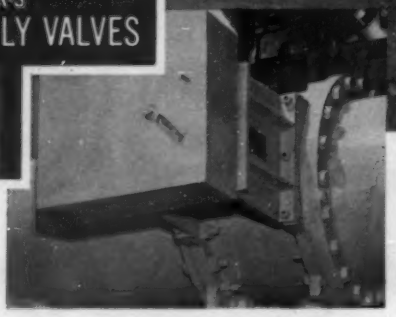

66 R-S Rubber-Seated Butterfly Valves, in sizes from 14" to 54", are used with hydraulic and manual operation in the new Filtration Plant.

Engineers:
Greeley and Hansen, Chicago

NIAGARA FALLS, N.Y. RELIES ON RUGGED R-S RUBBER-SEATED BUTTERFLY VALVES

The new Niagara Falls Pumping Station and 32 MGD Filtration Plant is one of the few big plants in the country almost entirely equipped with butterfly and cone valves. At this Filtration Plant, for instance, 66 R-S Rubber-Seated Butterfly Valves were specified for their ability to provide drop-tite, shut-off compactness and ease of operation. Satisfactory performance since the plant began operation in 1953 has resulted in an additional order of 42 R-S Rubber-Seated Butterfly Valves to rehabilitate the old Niagara Falls Filtration Plant.

Positive closure is assured by the wedging action of the valve disc periphery against a tough, flexible rubber seat, which seals the shaft bosses as well. Specially compounded rubber defies abrasion and resistance to the flow of materials for longer valve life.

If you would like to benefit by the design advantages and economics available in our complete line of butterfly, cone and ball valves, contact our local representative or write S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines
Pumps
Gates & Hoists
Trash Rakes
Accessories

HYDRODYNAMICS

Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

S. MORGAN SMITH CO.

AFFILIATE: S. MORGAN SMITH CANADA, LIMITED, TORONTO

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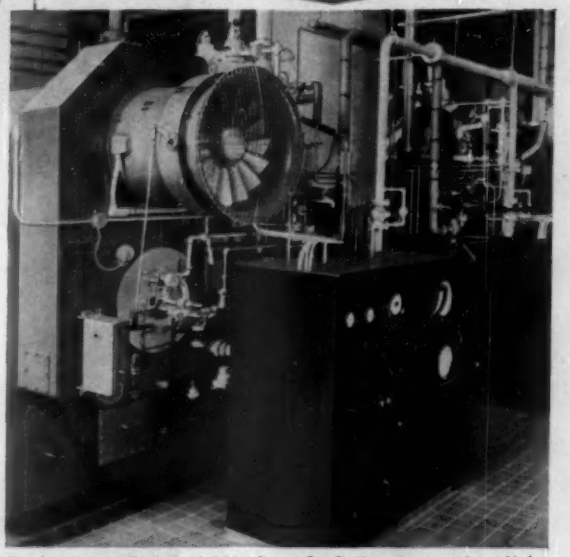
keeping steam cheap . . .

Low Cost Steam
produced here



Dual-unit installation of B&W Type FM Boilers at American Hoist and Derrick Company plant, supplying steam for processing and heating.

Helps American Hoist
cut costs here

Aerial view of large plant and facilities of American Hoist at St. Paul, Minnesota.

To reduce substantially its overall steam generation costs and overcome the problem of meeting wide and erratic load swings due to the use of steam hammers in the forge shop, American Hoist and Derrick Company of St. Paul, Minnesota replaced two old boilers with two B&W Type FM Boilers.

Now in service for over a year, the compact FM Boilers are providing steam for both processing and heating . . . are readily meeting all the service conditions under the direction of their automatic controls. Each unit has a steam capacity of 25,000 lb per hr at 200 psi, is equipped with a superheater to provide steam at proper temperature for various plant operations, and is designed to burn either gas or oil.

The FM Boiler is ideal for small to medium-sized operations, and has been widely applied to many larger installations as well, where multiple FM units have been found to be practical and more economical than one or more larger boilers requiring complete field erection and close operating supervision. The FM is self-contained and easy to install. For example, many have been set in place with equipment similar to that made by American Hoist. It is delivered complete with firing equipment and controls. This versatile steam generator is enjoying wide popularity with users in a large variety of industrial, commercial, institutional, and other classifications. The number of units now in service or on order have a total steam capacity of more than 9,000,000 lb per hr. It is available in standard sizes for loads ranging between 2900 and 36,000 lb of steam per hr at pressures to 235 psi. Special units for higher pressures are also obtainable.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

CONSIDER THESE COST-SAVING FEATURES

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

BABCOCK & WILCOX

BOILER DIVISION

G-686

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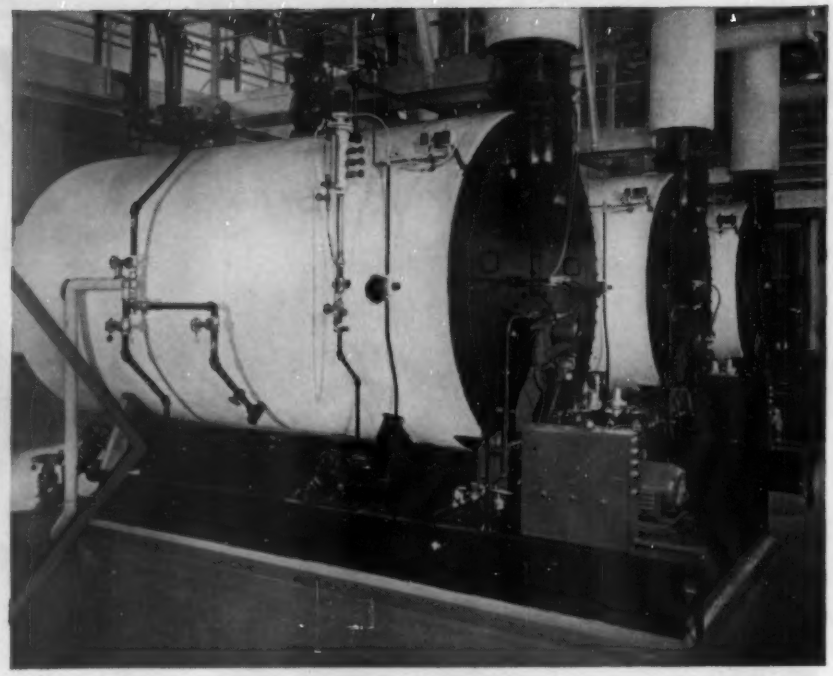
● Yarway Type "B" Seatless Tandem Blow-Off Valve. Note balanced sliding plunger design with no seat to score, wear, clog or leak. Pressures to 400 psi.



selected for these Cleaver-Brooks package boilers...

YARWAY BLOW-OFF VALVES

Cleaver-Brooks package boiler installations, like the one above, include as a very important part of the picture—YARWAY Blow-Off Valves.

As many boiler makers know . . . a *good* package boiler is a *better* package boiler when equipped with dependable accessories like YARWAY Blow-Off Valves.

Boiler buyers know, too, that YARWAY Blow-Off Valves are a stamp of quality.

Whatever make of boiler you buy or use, insist on this simplified design, dependable operation, long life and low cost maintenance provided by YARWAY Seatless Blow-Off Valves. *Over 15,000 boiler plant operators know and use them.*

For more details, write for YARWAY Bulletin B-426.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY

SEATLESS BLOW-OFF VALVES

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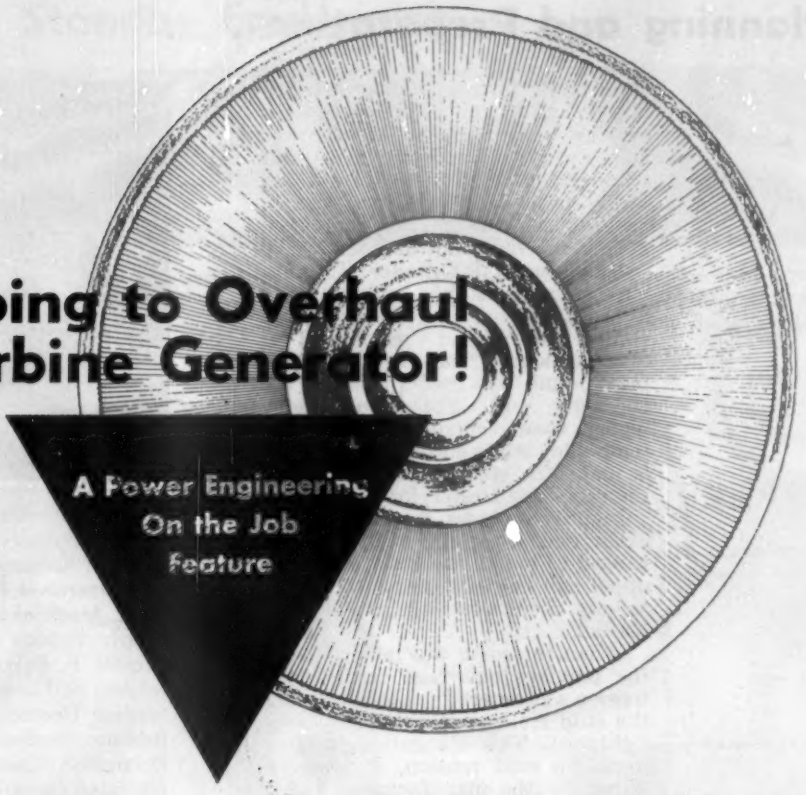
So—You're Going to Overhaul Your Turbine Generator!



II. Planning . . . Preparation . . . Preliminary Work

LAST MONTH WE showed a preview of a series of articles which will describe the recent overhaul of a turbine generator at U. S. Steel Corporation's South Works in Chicago. This article describes some of the planning and preparatory work and the first operations on the unit when it was shut down.

Planning

Standby Generating Capacity: The machine was rated 25,000 kw and was expected to be out of service for about a month, so arrangements had to be made for other power sources to be available during the shutdown.

Production Schedules: Not enough standby generating capacity was available to replace the full output of the unit, so the shutdown dates had to be chosen to fit a period of reduced steel production.

Standby Power: South Works interchanges power with U. S. Steel Corp.'s Gary Works, so Gary production schedules had to be considered when deciding the best time to carry out the overhaul.

Part of the power supply during the overhaul was to come from a series of old gas-engine driven generators at South Works, so preliminary work had to be done on these old machines to make sure they would be in good shape during the overhaul.

These gas engines are interesting because of their age and size. They were built between 1922 and 1931, and Figs. 4A, B, C, and D give some idea of their enormous dimensions. The cylinder shown in Fig. 4B has a diam of 60 in. and each of the three largest machines, generating 6000 kw, weighs (engine and generator together) about 1750 tons. An even more impressive figure is the weight of rotating components. For each machine the weight of rotating parts on one crankshaft amounts to a total of 270 tons.

When planning an overhaul, every plant will have problems of its own, but those discussed here give an idea of the kind of problems that have to be considered in good time for any overhaul if work is to proceed smoothly.

Coöperation: Conferences were held between U. S. Steel Corp. and Allis-Chalmers Mfg. Co., the manufacturers of the unit, to prepare work schedules, decide shift hours to be worked, allocate personnel from each firm, order materials needed, fix delivery dates, etc.

Figure 10 shows the schedule prepared for the overhaul. Such a schedule is not meant to be a rigid timetable, since for many of the operations it is impossible to know how much work will be required until the machine has been opened up and its condition determined. All the schedule does is to give everyone concerned enough idea of timing so that other operations can be scheduled to fit in with this particular shutdown. The schedule is also useful for checking actual times for each operation against estimated time, so that future estimates can be made more accurately.

Personnel: Normal maintenance work in a plant has to go on, no matter how big or important an overhaul. Yet few plants can carry enough maintenance personnel to be able to handle a big job on top of normal work without bringing in men from other departments. This planning has to be done well ahead of time so that the right men are available when needed, particularly as the schedules of many departments have to be considered.

Other details which had to be decided included the adjustment of vacation schedules to make sure work would not be interrupted during the overhaul, scheduling of other power plant work so the crane would be available when needed for the overhaul, arranging for proper tools and equipment to be available at the right time, etc.

A few days before the shutdown date, all materials needed for the overhaul were checked to make sure nothing was missing.

Start of Overhaul: As soon as the machine was shut down, the lagging, piping, and auxiliaries were removed from the turbine. While this work was in progress the unit was placed on turning gear to equalize heat distribution inside the machine. When a turbine is shut down, heat inside the casing rises and makes the upper half of the turbine hotter than the

lower half. The uneven heat distribution caused by the difference in temperature between the upper and lower halves would distort the spindle, and so it is uniformly cooled by being slowly rotated until the whole unit has had time to cool adequately — in this case for about 32 hours.

Unbolting H-P Cylinder: Tightening or loosening h-p cylinder stud nuts requires more force than can be applied with a hand wrench, and for this particular machine the power plant crane was used to obtain the necessary pull. For units having higher steam conditions and high temp alloy studs and bolts, provision is made for stud heating to obtain the necessary stretch for tightness.

Figure 8 shows how the crane cable, tied to the end of the wrench, is used to loosen the studs when the upper half has to be removed, and to tighten them when the cover is replaced.

When the cover was replaced after the previous overhaul, correct stud tension was determined by measuring the stud elongation as it was being tightened. This elongation, proportional to stud tension, is predetermined by the manufacturer, and is measured by a depth micrometer.

Figure 7 shows diagramatically how the depth micrometer is used to measure this stretch. Figure 9B shows the micrometer in position with the stud unstressed, and Fig. 9C shows the micrometer when the stud has been stretched the required amount. To explain the method, the elongation has been greatly enlarged. The actual extension will vary considerably, depending on the stud material, operating temperature, and required joint loading, usually amounting to a few thousandths of an in. per ft of effective stud or bolt length.

Fig. 1. Present at this planning conference at U. S. Steel Corp's Chicago South Works were: l to r, A. L. Berner, General Maintenance Foreman, Electrical; T. A. Watson, Superintendent Power Maintenance; A. L. LaForce, Asst. Supt. Mechanical Equipment Operations; George H. Krapf, Division Superintendent of Power Production; Wayne P. Palmer, now retired, then Division Superintendent of Power Production; C. H. Youngdahl, Superintendent Electrical Operations; O. E. Hogreff, Superintendent Mechanical Equipment Operations; H. W. Richardson, General Foreman, #5 Power Station; M. J. Moffatt, General Foreman, Mechanical Maintenance

Fig. 2. Checking replacement parts. Left, G. E. Johnson, Allis-Chalmers; right, H. W. Richardson, U. S. Steel Corp.

Fig. 3. Exciter and view of unit before shutdown. Crates in foreground contain tools to be used for the overhaul

This article is #2 in the series describing U. S. Steel's turbine generator overhaul. To follow in subsequent issues are:

3. **Removing turbine cover and spindle**
4. **Turning turbine cover after removal**
5. **Reblading the spindle and casing**
6. **Metallizing eroded section of shaft**
7. **Removing generator rotor from stator**
8. **Setting up for lathe work on turbine**
9. **Re-aligning the turbine spindle**
10. **Balancing rotating parts after assembly**
11. **Miscellaneous jobs done during overhaul**
12. **Safety measures and time-saving ideas**

Standby Equipment . . .

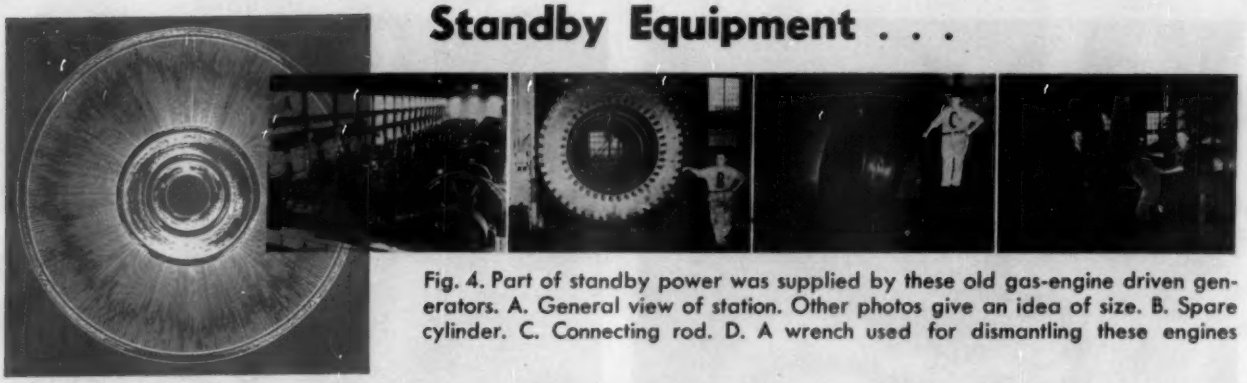


Fig. 4. Part of standby power was supplied by these old gas-engine driven generators. A. General view of station. Other photos give an idea of size. B. Spare cylinder. C. Connecting rod. D. A wrench used for dismantling these engines

Start of Overhaul . . .

Fig. 5. General view of unit before the overhaul

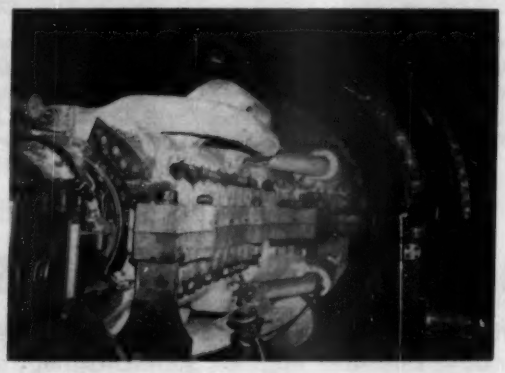


Fig. 6. Shows high pressure cylinder of turbine with insulating and lagging blankets removed

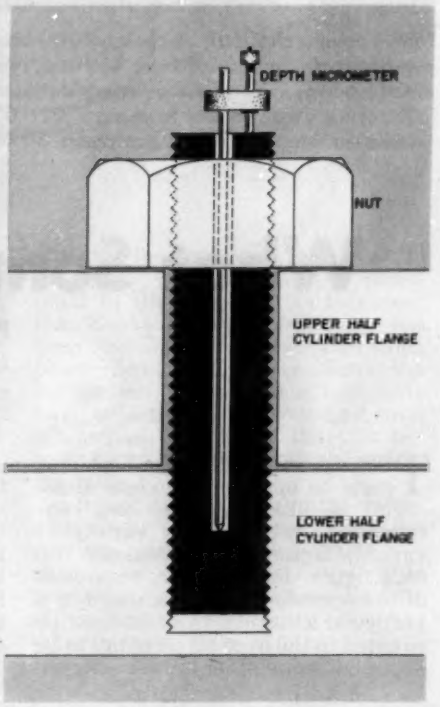


Fig. 7. Right. Section through stud showing depth micrometer for measuring stud elongation

Fig. 8. Loosening h-p cylinder stud nuts. Crane cable is attached to end of wrench

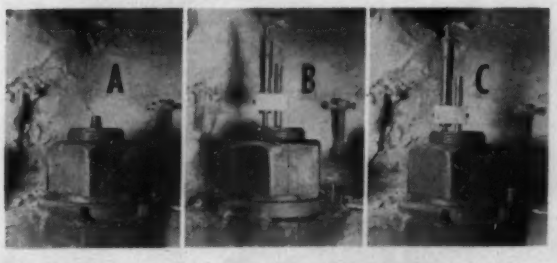
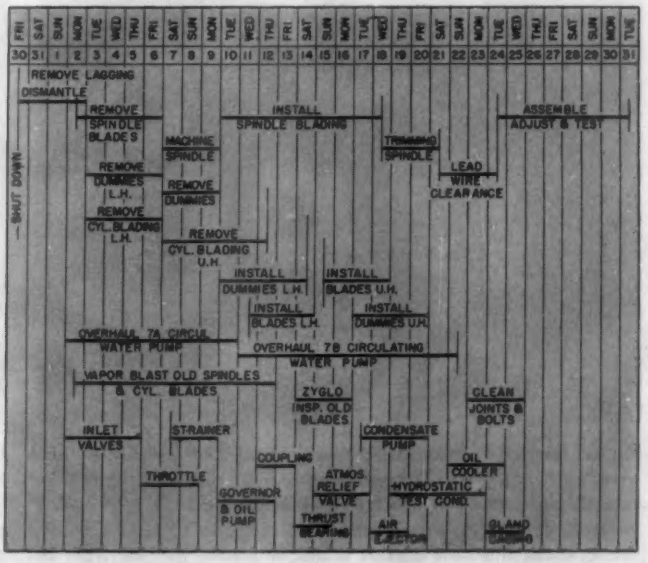


Fig. 9. A. h-p cylinder stud nut. Plug keeps hole clear when not in use. B. Micrometer in position, stud unstressed. C. Micrometer change measures elongation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SHUT DOWN
REMOVE LAGGING
DISMANTLE
REMOVE SPINDLE BLADES
INSTALL SPINDLE BLADING
ASSEMBLE
ADJUST & TEST
MACHINE SPINDLE
TRIMMING SPINDLE
REMOVE DUMMIES L.H.
REMOVE DUMMIES
LEAD WIRE CLEARANCE
REMOVE CYL. BLADING L.H.
REMOVE CYL. BLADING U.H.
INSTALL DUMMIES L.H.
INSTALL BLADES U.H.
INSTALL BLADES L.H.
INSTALL DUMMIES U.H.
OVERHAUL 7A CIRCUL. WATER PUMP
OVERHAUL 7B CIRCULATING WATER PUMP
VAPOR BLAST OLD SPINDLES & CYL. BLADES
ZYGLO INSP. OLD BLADES
CLEAN JOINTS & BOLTS
INLET VALVES
STRAINER
CONDENSATE PUMP
COUPLING
OIL COOLER
THROTTLE
ATMOS. RELIEF VALVE
HYDROSTATIC TEST COND.
GOVERNOR & OIL PUMP
THRUST BEARING
AIR EJECTOR
GLAND

Fig. 10. Schedule shows estimated time for the main operations of the overhaul

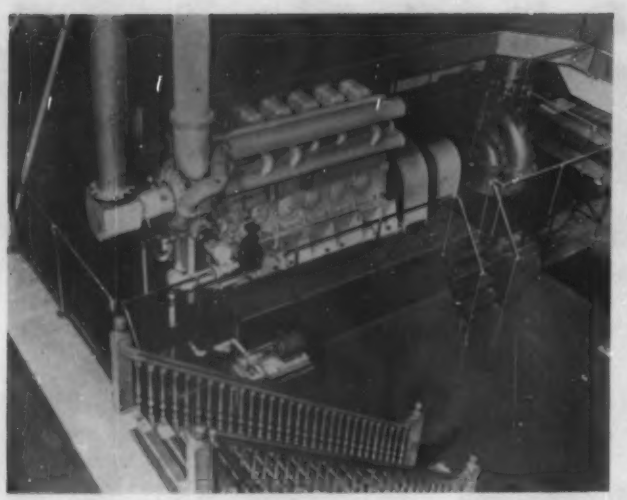

Fig. 1. Supercharged, 4-cycle, 1000-hp diesel standby pumping unit for City of New Bedford, Mass., supplements electric pumps in municipal pumping station. With fuel cost at 10½ cents, average cost to pump 1,000,000 gal is $5.28. Investment was $115,000, can pump 30,000,000 gal/day

Fig. 2. Dual-fuel 1000-hp diesel with 700-kw generator at Forest City, Iowa, municipal power plant is addition to four other engines. In 29 months, unit generated 7,336,260 kw hr at fuel cost of 3.89 mills per kw hr, with gas at 26 cents per MCF, oil at 11 cents per gal. Investment was $150,000

What Some Modern Diesels Cost

Progress toward increased efficiency in diesel operation has been steady; dual-fuel engines, supercharging, have contributed to fuel economy. Here, in cross-section, are some modern average costs

THE QUESTION OF WHAT it costs to operate a modern diesel engine is, like any other cost consideration, subject to a variety of variable factors which influence the final figure. Furthermore, regardless of the operating cost of a diesel in a particular situation, this cost must be equated to the over-all economy to be expected from other power sources.

It is always advisable to draw upon the services of those who have the necessary engineering and statistical background to interpret the accumulated data of a planning study made for the purpose of determining when, how much, and what kind of power shall be adopted for plant expansion or modification.

In each of the eight examples of diesel operating costs displayed here, a detailed analysis was made of the requirements, the possible solutions, and the long-range effects on plant economy before the decision was made to add or adopt diesel power.

An effort has been made to present a fairly representational cross-section of typical diesel application in typical plants. Costs given in the illustration

Fig. 3. Two 1440-hp supercharged dual-fuel 8-cylinder engines at Auburn, Nebr., replaced several older straight diesels. Though power production was increased from 4,395,825 kw hr to 4,587,380, expenses were reduced $21,815. Dual-fuel cost for the new diesels is below 3 mills per kilowatt hr

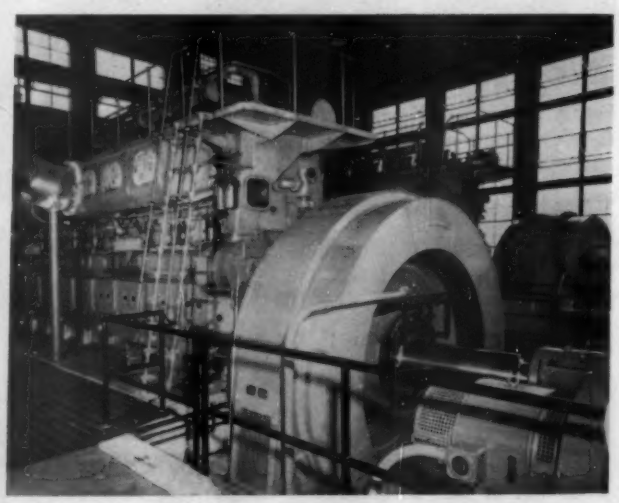

Fig. 4. City of Bluffton, Ind., installed two 10-cylinder, 3500-hp diesel engines and mothballed steam equipment. In 1953, new diesels produced 11,491,000 kw hr. Two units produced 3,614,400 kw hr. With fuel oil at 11.1 cents/gal, over-all plant fuel cost was 8.2 mills per kilowatt hour

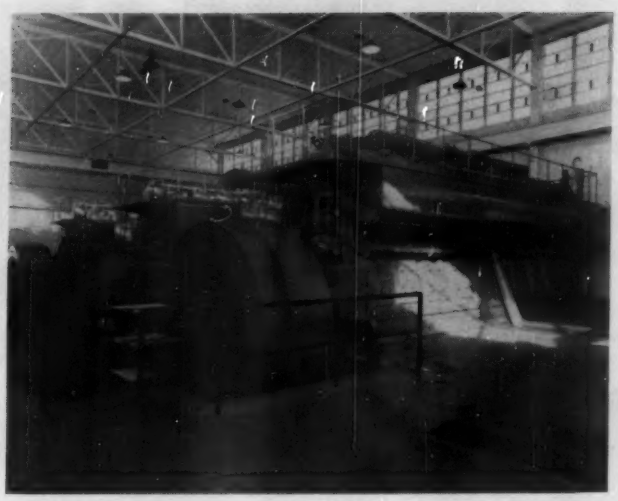

Fig. 5. Johnson plant of Wolverine Co-Op, Mich., won efficiency award with three 3500, two 1010, and one 1650-hp dual-fuel engines. A 3500-hp unit was tops with low average of 9455 Btu per kw hr. It produced 8,680,700 kw hr at rate of 8.83 cu ft of gas, 0.0063 gal pilot oil per kw hr

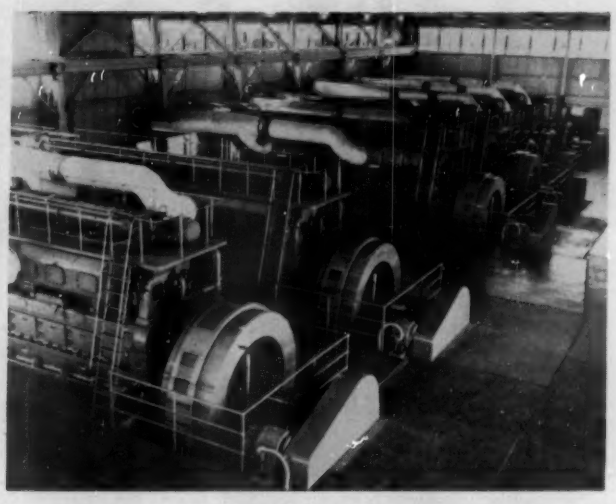

Fig. 6. New Mexico's Lea County Co-Op operates four 3500-hp and three 1600-hp dual-fuel engines. In representative year, these units generated 24,707,300 kw hr at average fuel cost of 2.87 mills per kw hr with gas at 19 cents per MCF and oil at 9.34 cents. Cost was 5.26 mills/kw hour

captions are accurate so far as we can determine. However, the basis for all costs as shown may differ. In many cases, it is not known whether the unit costs were figured on the basis of net, or gross, kilowatt hours. Nevertheless, the costs quoted agree very well with the national averages — all things considered.

The standby pumping unit for the City of New Bedford, Mass., shown in Fig. 1, recently justified its purchase when hurricane "Carol" roared through New England. Cut off from electric service for almost two days, the municipal water pumping station was able to supply the area with this vital service by virtue of the diesel's ability to pump a total of 42,187,500 gallons of water in that emergency.

The two 3500-hp engines illustrated in Fig. 4 are an interesting diesel application. These two units replaced the last steam turbines still in service at the municipal power plant in Bluffton, Ind. In this case, the steam turbine equipment has been mothballed for the future when power demand increases. Since the installation of the diesels, fuel costs have been cut 18 per cent and total production costs more than 20 per cent. This situation is summarized in the table.

A table of operating statistics, Bluffton

Item	1952	1953
Gross kw hr	12,699,750	15,105,400
Kw hr, steam	5,046,250	.....
Kw hr, diesel		
1400-hp	5,326,100	3,614,400
3500-hp	2,327,400	11,491,000
Plant fuel cost*	10.1	8.2
Production cost*	15.1	11.9
Net profit*	2.9	4.0
Net profit, total	$37,297.90	$60,696.95

*in mills per kw hr

For additional background information on diesel engine costs, the reader is referred to the latest *Report on Oil and Gas Engine Power Costs* published by The American Society of Mechanical Engineers. This is obtainable from the Society at 29 West 39th St., New York 18, N. Y.

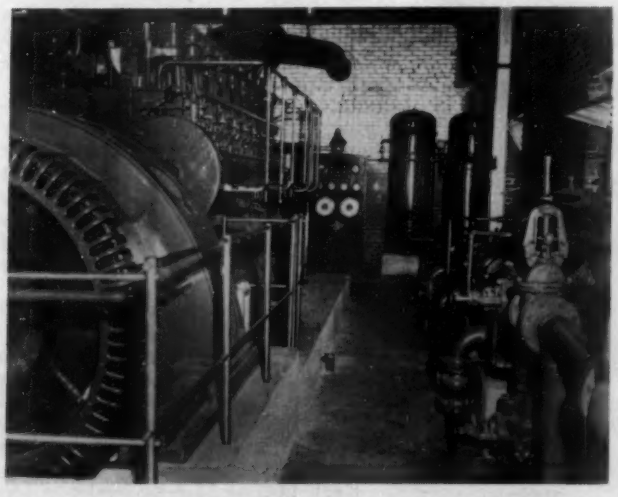

Fig. 7. Diesel generating set for standby and peaking service installed by municipal plant at Quakertown, Pa., complements three-unit 6000-kw steam plant. Supercharged, 8-cylinder, 1560-bhp unit averages 8.3 mills per kw hr using premium fuel oil and lube oil during the break-in period

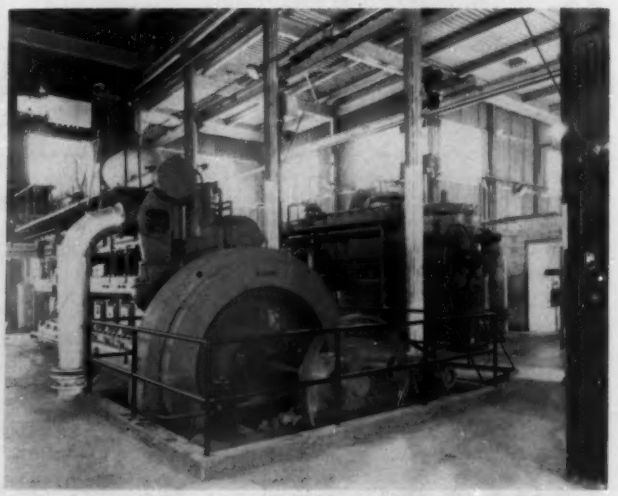

Fig. 8. Lake Providence, La., municipal light plant has 4 diesels; latest is 10-cylinder, 2000-hp dual-fuel engine. In 6-month period, total output was 3,167,000 kw hr, 40 per cent from 2000-hp unit. With gas at 22.5 cents/MCF, pilot oil at 10 cents/gal, plant costs were 3.86 mills per kw hr

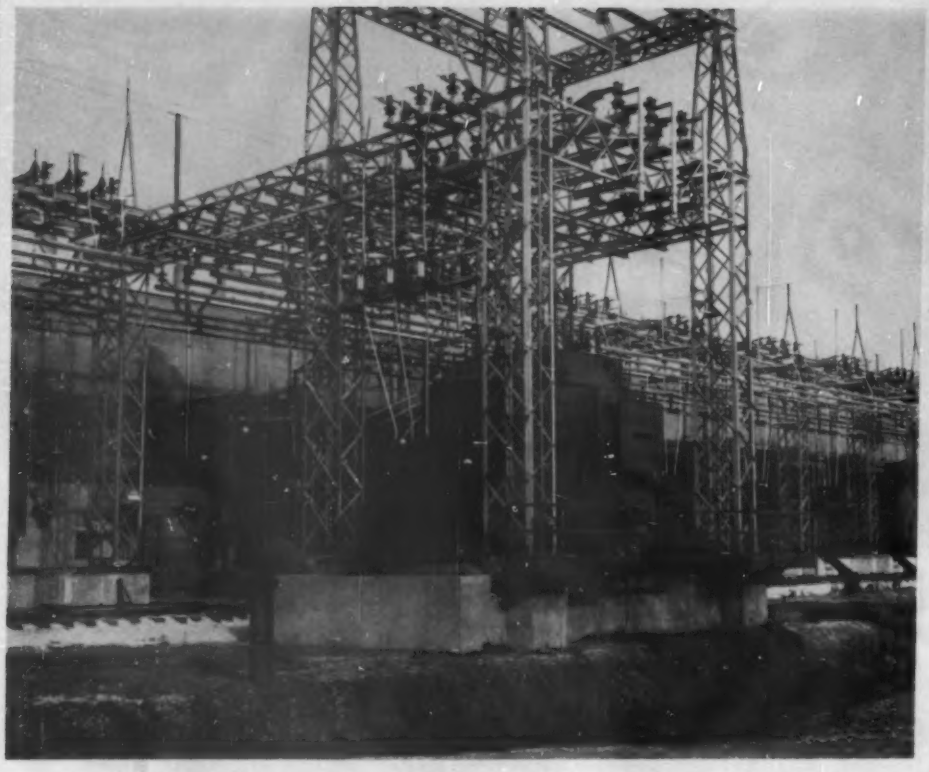

Fig. 1. Rectifier regulating transformer shows in foreground. The phase shifting transformers are lined up, background

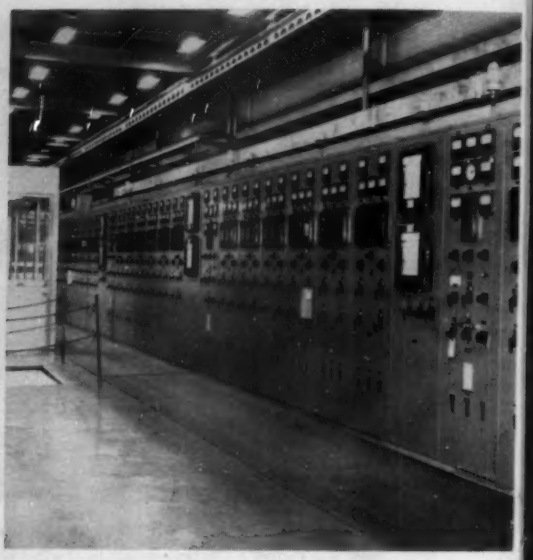

Fig. 2. View of rectifier control panel shows a corner of air-conditioned office

How Kaiser

This is the second article on Kaiser Aluminum & Chemical Company's big new aluminum plant in Chalmette, La. Here is how they rectify a-c power from the steam plant to supply 6 of 8 potlines in reduction plant

By E. F. BOOBYER *

CHALMETTE WORKS alumina electrolytic reduction facilities comprise eight "potlines" of which two are fed with d-c power directly from the d-c generators in the Gas Engine Plant, and the remaining 6 potlines from 6 rectifier lines incorporated in one Rectifier Station.

Rectification equipment and transformers were procured at relatively short notice as new machinery, or from mothballed rectifier facilities at wartime alumina reduction plants. The station is equipped with mercury-arc rectifiers so that banks of rectifier frames serve a single potline as an integrated unit.

Power at 13.8-kv ac is delivered to the Rectifier Station through ACSR-1, 1,033,500-cm aluminum cable supported from steel towers and shielded by a static overhead wire system. Independent 13.8-kv feeders supply each line of rectifiers from the Steam-Electric Plant.

Each potline 13.8-kv feeder is terminated in the Rectifier Station switchyard at a regulating transformer, incorporating a motor-driven

*Power Manager, Chalmette Works, Kaiser Aluminum & Chemical Corp.

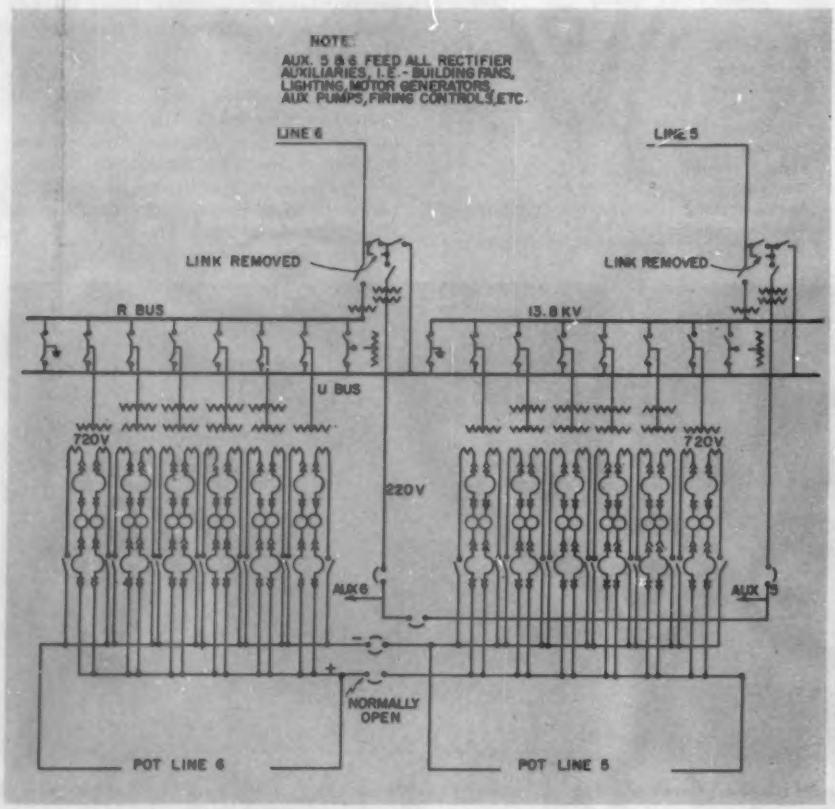

Fig. 5. Illustration shows schematic diagram of the electrical distribution to potlines 5 and 6. Potlines 3, 4, 7, and 8, are similar. Potlines 1 and 2 are supplied by the 80 gas-engine driven d-c generators which were described in a previous article

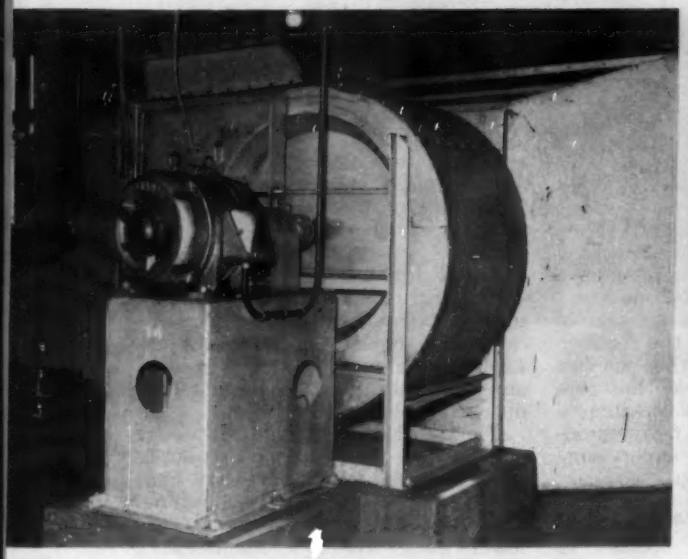

Fig. 3. One of 39 fans that pressurize and ventilate the big rectifier station

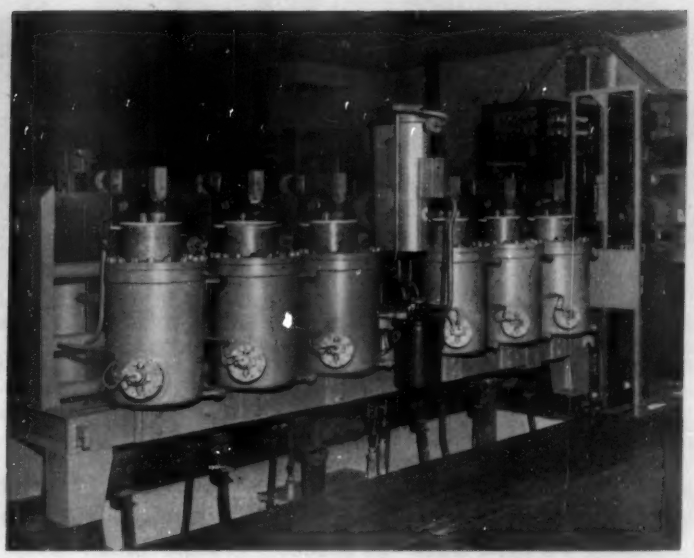

Fig. 4. A frame of mercury arc rectifiers. Plant has a total of 78 frames

Rectifies Power for Potlines

step tap changer capable of providing ± 10 per cent voltage regulation, to the 13.8-kv, 720-v rectifier transformers that in turn supply the anodes of the bank of rectifiers serving the potline. The regulating transformers are protected by a case ground relaying system and are mounted on rails adjacent to a standard-gauge railroad. The rectifier transformers each serve two rectifier frames through a balancing coil and anode breakers. Aluminum cable and bus is utilized throughout and overhead static wiring employed where cable is exterior to buildings.

The d-c power demand by each individual potline is on the order of 65,000 amp at 720 volts. In each case, this is supplied from the bank of rectifier frames comprising either 12 or 14 frames, rated at either 6000 or 5000 amp, respectively, and the power is delivered through rectifier frame cathode breakers to the main d-c bus in the individual Potroom. This bus is also aluminum, constructed of 16 sheaves of 12- by 1-inch bar. All bus connections are welded.

Centralized Instrumentation

The Rectifier Station operating crew has centralized supervisory instrumentation to aid the operation of the Station and normally responds to requests from the Potrooms to maintain certain constant voltages of 700 to 720 volts dc to the individual potlines. Requests for discontinuance of power to any potline are fulfilled by operating the master trip switch that opens all of the appropriate cathode breakers simultaneously. This operation is followed by the opening of the master excitation switch that interrupts the firing circuitry to the appropriate bank of rectifiers.

An arcback within the rectifier system is reflected by a reversal of current through the anode breakers. Such a reversal results in the rapid opening of the anode breakers (within ½ cycle) receiving the reflection of the arcback; this is the sole function of the anode breakers. Arcbacks are generally the result of overloading the individual anode tanks, decaying vacuum in the anode tanks, abnormal anode tank temperature, displacement of mercury from the cathode mercury pool, abnormal behaviour of the excitation control or malfunction of the ignitor tip, etc.

Each pair of rectifier frames is fed from a wye connected, 13.8-kv, 720-v rectifier transformer through a balancing coil. The rectifier transformers have a single 3-phase primary winding and two secondary windings, each consisting of two 3-phase windings displaced by 180 degrees. In this manner, a 3-phase primary voltage results in a 36-phase secondary system where the current is fed to the two rectifier frames, each of which comprises a group of 12 tank-enclosed anodes. Each tank holds a cathodic mercury pool, and all 12 cathodes are connected to a common cathode bus so that the rectified current flows through a cathode breaker to the main positive bus supplying a potline. A total of either 12 or 14 rectifier frames feed into this main positive bus through individual cathode breakers.

The main negative potline bus is connected through disconnect switches to the neutral points of the rectifier transformers secondary windings associated with the potline.

Rectification of the a-c current to d-c current is accomplished through unidirectional current flow characteristics imposed by the structure of the individual mercury-arc rectifier tanks. Flow of power through these tanks is by means of a stream of electrons liberated from the cathode mercury pool and traveling to the graphite anode; such a flow is always toward an electrode more positive than their source. Because only the mercury pool is capable of emitting such a stream of electrons, current can flow only when the graphite anode is more positive than the cathode, and the stream of electrons is sustained. When the anode is less positive, the electron stream ceases to bridge the gap between cathode and anode.

Tanks Evacuated

The rectifier tanks are essentially vacuum tubes and must be evacuated to an absolute pressure of about 0.001 mm of mercury for favorable operation. A higher pressure results in unreliable performance due to the action of the contained oxygen. Mercury vapor is present above the mercury pool and the density of this vapor influences the character of the mercury arc rectification, so that a nominal temperature must be maintained at the inner surfaces of the rectifier tanks. The energy loss in the function of rectification is resolved in the form of heat released inside the tanks and is removed by a tank jacket cooling water system.

Each rectifier frame is equipped

with a vacuum pumping system servicing all 12 rectifier tanks mounted on the frame. First stage of pumping is by a mercury-diffusion, 3-stage, vacuum pump, followed by a non-return trap and a motor-driven rotary vane-type vacuum pump exhausting to the atmosphere.

Each rectifier frame is supplied with a separate closed cycle jacket cooling system, pumped by a centrifugal pump, and using treated distilled water. This water is in turn cooled in a tubular heat exchanger by treated domestic water supplied from a cooling tower system serving the entire Rectifier Station.

Because the flow of current within any and all the anode tanks comprising a rectifier frame is dependent upon the initiation of an electron stream from the mercury pool to the anode during that part of the pulsating a-c cycle when the anode is more positive than the cathode, control of the initiation of the electron streams dictates the character and extent of rectification within the rectifier frame. By controlling the time at which the electron stream flows, and consequently when the arcs are started, the portion of each cycle that the individual tanks conduct is controlled and limited, if necessary. By averaging the portion of each cycle the tanks conduct with the balance of the cycles during which there is no conduction, the average output d-c voltage of the rectifier frame is controlled. By increasing the portion of the cycle of conductance, the average frame output voltage is increased.

Ignitor Tips Provided

Each tank is equipped with an ignitor tip capable of causing the initial electron stream and the subsequent arc of rectification. The individual ignitor tips of the tanks comprising a rectifier frame are supplied with a saturation current in the order of 2 amp, in strict controlled sequence and rotation so that the pattern of rectification arcs is established. The a-c current supplied to the firing circuit is of the same quality and character as supplied to the tank anodes of the associated rectifier frame.

Normally each line of rectifier frames serving a potline is an integrated unit. Both main and auxiliary power is fed from an independent 13.8-kv feeder from the steam plant. Each line of rectifier frames feeds a single potline only with d-c power. Sufficient capacity is apparent at the rectifiers, so that any single frame can be switched-out for maintenance without inflicting a d-c power curtailment to the potline.

Voltage control of the d-c power is effected by the operators by manipulation of the step-type tap changer at the a-c regulating transformer and of the firing circuitry of the anode tanks. In emergency situations where abnormal loss of rectifier frames in any one system threatens power curtailment to a potline, the positive d-c bus effected can be paralleled through switchgear with a neighboring positive bus where excess capacity is available. The two d-c negative busses involved are connected through a link.

Failure of the individual a-c feeders or regulating transformers is remedied by emergency switching to an "unregulated" 13.8-kv bus supplied from a separate source in the steam plant and located in the rectifier station switchyard. This a-c bus is continuous the length of the rectifier station and power from this bus can be switched into any of the sets of rectifier transformers feeding a single potline. Protective relaying devices provide automatic supervisory control to prevent damage.

Overcurrent Protection

Failure of an anode breaker to interrupt a short circuit occasioned by an arcback or other incident, or a short circuit be evident at a rectifier transformer, would result in an excessive a-c current flow to the fault. A time-overcurrent relay and an instantaneous overcurrent relay are provided to sense such a fault and operate to open the associated main a-c feeder at the feeder breaker in the steam plant.

Each regulating transformer, rectifier transformer, and auxiliary power transformer is protected against a fault of windings to ground by a case ground relay that operates to open the associated a-c feeder breaker in the steam plant.

All these relays are capable of operating to open the breakers in the steam plant controlling the flow of power to the unregulated bus in the rectifier station switchyard. This protects against damage when the unregulated bus is actually feeding at potline.

The main a-c feeder breakers to the rectifier station are operated to open by time-overcurrent and phase differential sensing relays, capable of sensing abnormal conditions on the individual feeders from the main breakers to the regulating transformers located in the rectifier station switchyard.

All a-c power buswork, switchgear, and transformers associated with the rectifier station is exteriorly mounted, with the exception of the anode breakers, and all d-c power equipment is contained within the 2-storied brick building comprising the rectifier station. The operators are supplied with an air-conditioned control room and the main building is pressurized by filtered air in order to minimize the influx of dirt. This is necessary because nearly all d-c power buswork and equipment is fully exposed and therefore susceptible to spillovers due to dust accumulation. Additionally, some of the lost electrical energy within the station appears in the form of radiated heat and must be carried away by the circulation of air through the continuous jackroof exit of the building.

A series of fans located within the building pull air through individual, slowly rotating mesh screens, coated with a viscous petroleum product, so that the incoming air impinges on a maze of tacky surfaces to leave the borne dirt and continue as relatively clean air. These screens pass through a bath of the oil located outside the air stream, where much of the dirt is washed off the screen and precipitated and the screen is replenished with an oil film. Periodically, the screens and oil baths are washed in solvent, the oil reclaimed and the oil tank refilled with reconditioned and new oil.

The Control Room and supervisory cubicles are located on the upper deck in an uninterrupted bay near the center section of the building. Here also is a hatch entrance to the lower deck where a maintenance shop is located, occupying an area of equal size. All maintenance of equipment within the rectifier station is handled in this shop.

Maintenance

Philosophy of maintenance of the 78 rectifier frames (936 anode tanks), switchgear, and control circuitry is one of maintenance by "records and performance" rather than strictly of the "preventive" type. Extensive records of performance are used as an indication of what maintenance is considered necessary. Preventive maintenance technique is only applied to those elements that are known to have a specific useful life, such as selenium rectifiers and resistors in control circuitry, breaker contacts, etc.

Capacity of station	338,625 kw ac
* Average rectification efficiency	94.5 %
Average monthly load factor	87.02 %
Average monthly availability	96 %

* All auxiliary power for pumps, lighting, building fans, etc., and all the transformer losses are considered in this statistic.

"Hmmm . . . . . been straining your eyes lately?"

The mezzanine floor of the Sherman Hotel in Chicago bustled with activity as over 2600 of America's top engineers registered for the seventeenth annual American Power Conference. At left, traffic signs direct newcomers. Center, R. F. Andres, Dayton P&L, and W. E. Hare, Allen-Sherman-Hoff, talk things over; right, L. C. McCabe, U. S. Dept of Interior, and G. R. Morgan, Ontario HEPC, renew associations

America's Only All-Power Conference Sets New Records for Value

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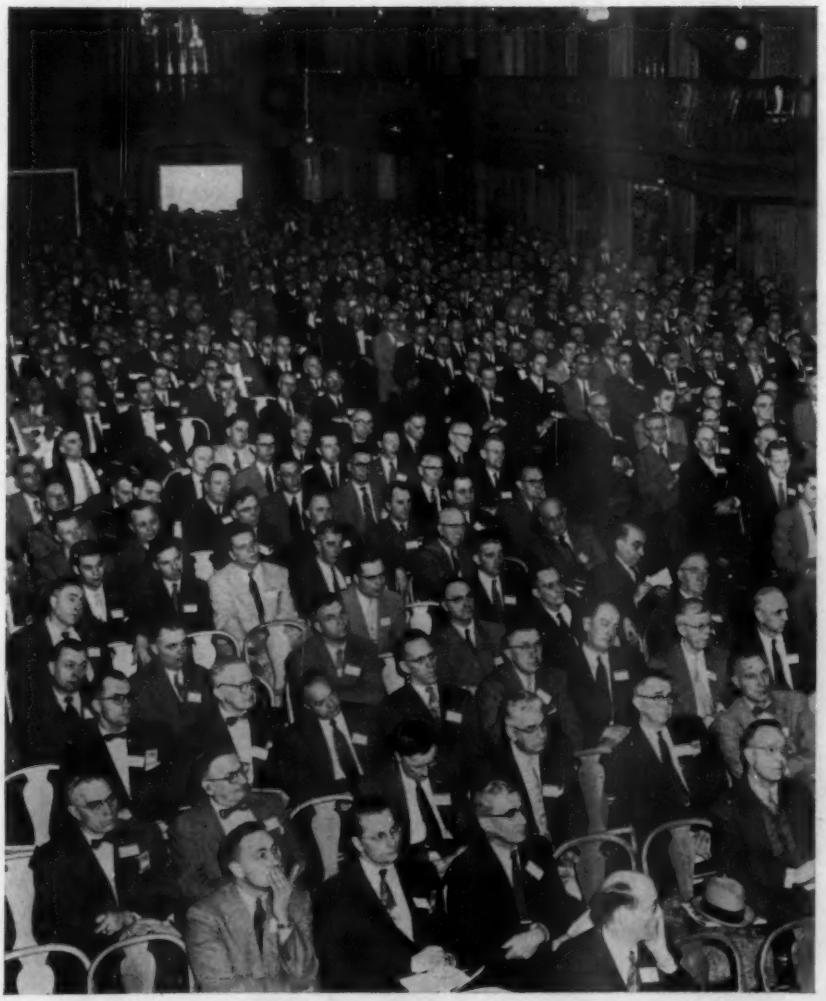

HERE WAS a real 6-power conference, covering steam, diesel, gas turbine, hydro, atomic power — the 17th annual meeting of American Power Conference at Hotel Sherman, Chicago, March 30, 31, April 1, 1955. Some 2600 power engineers from every section of the country attended. It has become, over the years, the only national conference in the U. S. devoted solely to power engineering problems. POWER ENGINEERING'S entire staff covered it with camera and notebook.

In following pages, you will find a broad brush treatment to give you the atmosphere of the conference, with highlights of a few of the technical papers. Complete papers will all be available in the published Proceedings of the Conference to be issued soon, so we are publishing here only brief abstracts.

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Blue Blush on Metals

By FREDERICK G. STRAUB*

DURING the last few years attention has been called to the sticking of valve stems in the higher pressure, higher temperature steam turbine valves. The valve stems and bushings are found coated with an adherent, very hard coat of a blue-black material. This has been commonly referred to as "blue blush." It appears to grow to sufficient thickness to cause sticking of the valve assembly.

When this blue-black material was removed from the base metal and analyzed, it was found to be very pure magnetic oxide of iron. None of the alloying materials of the base metal appear in the oxide coating. X-ray diffraction analyses show the only pattern developed to be that of magnetic oxide of iron (Fe_3O_4). The absence of other materials present in the base metal might indicate that the base metal is not being oxidized to form the iron oxide but that it could be coming from some other source.

In order to determine the source of the material in this hard coat of Fe_3O_4, tests were started in April, 1953, in the Chemical Engineering Research Laboratory at the University of Illinois in cooperation with the Utilities Research Commission of Chicago, Illinois. These tests involved the preparation of a very pure steam, superheating the steam, and then passing the superheated steam over specimens of various types of metals used for making valve stems and bushings. The specimens are removed after a predetermined time of contact and examined. The increase in diameter of the specimens is used as an index of the amount of the coating forming on the specimen.

The conclusions which appear evident from the results of these tests and the steam plant operating results are as follows:

1. The hard adherent iron oxide film forming on valve stems and bushings is magnetic oxide of iron resulting from a reaction of the iron in the base metal with the superheated steam.
2. All nitrided metals which have been reported used in valve assemblies and which have been tested show an appreciable steam oxidation rate at the temperatures of the tests.
3. The 440-A Chrome Steel was found to be very resistant to the steam attack.
4. Several Stainless Steels are resistant to this action of the steam.
5. Chromium and Lustralloy plating appear to show resistance to attack when plated on corrosion resistant base materials.

* Research Professor of Chemical Engineering, University of Illinois.

Harold Quinton, EEI pres., addresses luncheon meeting. Seated are Dr. Potter, BCR, A. D. Bailey, ex-Com Edison

At the conference luncheon on Thursday, Clarence H. Linder, vice-president of General Electric, spoke on "Human Resources in the Technological Future"

Fischer Black (Electrical World) hears A. M. Beebe (Rochester G & E) speak at All Engineers Dinner. Right, H. Sedwick and A. C. Monteith (Westinghouse)

Registering are R. E. Whitford (Reynolds Metals Co.), George C. Sullivan (Chief, Util. Br., Hq USAF, Wash.) and George Grimm (Chief, Utilities and Installations, Office of Sec. of Defense, Wash.)

Photo subjects named l. to r. in all captions

Fault Location by Radar

By H. L. GARTON *

RADAR AS A TOOL in locating faults on overhead lines, underground power cables, and multi-conductor control and communication cables is described in this paper. The Radar Fault Locator for finding the position of permanent faults is already in practical use.

Method of operation of the Radar Fault Locator is as follows: A pulse of energy is sent out over a line or cable and a portion of the energy is reflected by an impedance discontinuity back to the receiver, where it is detected. The transmitted and received pulses are displayed on a cathode ray tube and a ranging device is provided to measure the time interval between the transmitted and received pulses.

Method of operation of the proposed transient fault locator is as follows: On each end of a line a one megacycle crystal-controlled oscillator would be installed. The fault generated surge would travel both ways to a receiving station and a sending station. At the receiving station, the surge would start a time delay circuit of 1 sec. After one sec, a counter at the receiving end would start to count microseconds. On the other end of the line, the fault generated surge would start a 1-sec time delay circuit. At the end of one sec, a transponder would send a pulse down the line to the receiving station. Receipt of this pulse would stop the counter.

The reading on the counter at the receiving end could be translated into actual distance to the fault by means of charts.

This latter equipment is under bread board construction and field tests have not yet been conducted.

* Senior Engineer, Testing Dept. Commonwealth Edison Co.

Paul O. Kock, Bituminous Coal Research, Inc., Columbus, Ohio, and Raymond Hagenmiller, Associate Editor of POWER ENGINEERING are caught in gay mood by photographer in our Hospitality Suite

Centralized Control of Boiler and Feedwater Chemical Treatment

By RUSSELL C. ALEXANDER, WAYNE M. HAGUE, and JACK KORENTHAL *

AN ARRANGEMENT for the sampling, testing, and chemical treatment for two boiler-feedwater systems in one central room, effectively utilizing modern automatic chemical control and recording equipment, was described by this paper. The centralization of sampling, testing, and chemical treatment facilities for station auxiliary systems is also described.

Based upon operating experience at the Valley Steam Plant, it is believed that there is ample reason to recommend this method of centralizing plant chemical activities and control in charge of trained specialists instead of general plant personnel.

Valley Unit 1 began operation on September 20, 1954, and Unit 2, on December 10, 1954. No large problems were encountered with the described sampling, testing, and treatment equipment. The centralization of the equipment proved to be of paramount value during early operation when the raising of boiler pressure and evaporation rates caused the usual scrubbing of boiler and piping surfaces and raised the quantities of dissolved silica and suspended matter.

The centralization of all functions of sampling, testing, chemical feeding and blowing down provides not only the means, but also insures adherence to narrower limits of concentration for the entire cycle. Typical limits are shown in the adjoining table.

* Valley Steam Plant, Dept. of Water & Power, City of Los Angeles.

Table of Chemical Controls Exercised at the Valley Steam Plant

SAMPLE	TESTS	LIMITS
Boiler Water	M-alkalinity	100–125 ppm
Boiler Water	pH	11.0–11.3
Boiler Water	Sulphite	3–8 ppm
Boiler Water	Phosphate	10–20 ppm
Boiler Water	Silica	5 ppm Max.
Boiler Water	Total Solids	500 ppm Max.
Boiler Feedwater	pH	8.5–9.0
Boiler Feedwater	Conductivity	5 Mmhos Max.
Boiler Feedwater	CO_2	0 ppm
	Ammonia	0.06 ppm Max.
Steams	pH	8.0 Minimum
Steams	Conductivity	1.5 Mmhos Max.
Condensate	Silica	0.07 ppm Max.
Condenser Cooling Water	Total Solids	2,000 ppm. Max.
Condenser Cooling Water	pH	7.0–8.0
Condenser Cooling Water	Polyphosphate	2–6 ppm
Bearing Cooling Water	Total Solids	1,000 ppm Max.
Bearing Cooling Water	pH	7.5–8.0
Bearing Cooling Water	Polyphosphate	2–6 ppm
Demineralized Water	Total Solids	1 ppm Max.
Demineralized Water	Silica	0.2 ppm Max.
Demineralized Water	pH	8.0–9.0
Average Demineralizer Final Effluent Concentration		0.1 Silica 8.4 pH 0.0 CO_2

J. R. Jones, Texas Electric Service, R. H. Bradford, Ebasco, Chicago, and H. R. Pearson, Iowa P&L, Des Moines

S. P. Griffin and Arthur Kleinroth, both of Commonwealth Edison, Chicago, pause for a moment to be photographed while attending Conference

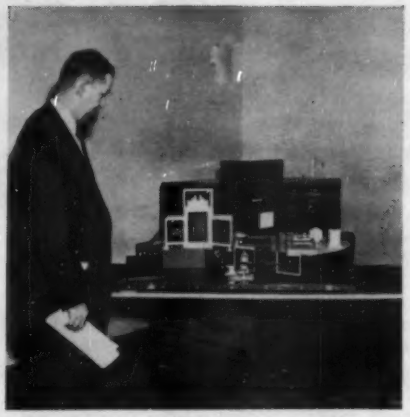
Irene Glen, of POWER ENGINEERING staff, issues prize number tags to E. Michalek, G. Chamberlain, and Bob Harper of the Peoples' Gas Company, Chicago

Three gas turbine authorities attending the session were A. A. Hafer, General Electric Company, Comdr. William M. Fowden, Gas Turbine Branch, BuShips, and W. B. Wilson, also of General Elec.

Posing for POWER ENGINEERING'S photographer are J. Stanley Brown, Duquesne Power & Light, F. C. MacKrell, Stone & Webster, and J. F. Fairman of Consolidated Edison Co., New York City

Paul F. M. Waller, Combustion Engineering Inc., Minneapolis; D. A. Sullivan, Commonwealth Edison Company, Chicago; and Hubbell Carpenter, of Minneapolis Power & Light Company, Duluth

Dot Merrill, Merrill & Co., Vice-Pres. and Sec. of Society of Women Engrs.; Dick Morris, Ed. Director POWER ENGINEERING; Prof. Lois G. McDowell, of IIT



J. R. Jones, of Texas Electric Service Company, at North American Aviation Corp.'s atomic power plant exhibit

Multi-Fuel Boiler Control

By PAUL THANOS *

A POWER EXPANSION program recently completed at Inland Steel Company, Indiana Harbor Works, included the installation of a new 200,000 lb/hr boiler. This boiler was installed in our No. 3 A.C. Station to augment the output of the four original boilers which are rated at a slightly lower capacity.

Our No. 3 A.C. Station (the location of the new boiler) has a capacity of 30,000 kw and will use either blast furnace gas, coke oven gas, or oil, either singly or in any combination depending on the availability of the by-product fuels. Natural gas, when available, is also introduced into the blast furnace gas main to enrich the gas.

The combustion control follows this sequence of operation:

1. The steam pressure regulator will increase or decrease the air flow as a function of steam demand. The furnace pressure regulator operates the louvers of the I.D. fan to maintain a constant pressure in the furnace.

2. The air flow transducer measures the air flow into the boiler and provides a signal of fuel requirement which is applied to both oil amplifier summarizer and blast furnace gas amplifier summarizer.

3. The blast furnace gas amplifier summarizer will set the blast furnace gas flow regulator to provide enough blast furnace gas to burn the air in the furnace, except when the blast furnace gas pressure is down to 17 in. of water pressure. If coke oven gas is being utilized, then the blast furnace gas amplifier summarizer will subtract the amount of coke oven gas already going into the boiler before adding blast furnace gas.

4. In addition, if the operator has a set minimum oil flow, the blast furnace gas amplifier will subtract this quantity of fuel before setting the blast furnace gas flow regulator.

5. The oil amplifier summarizer will add the actual blast furnace gas flow into the system and the coke oven gas flow and subtract it from the total fuel requirements to set the oil flow regulator.

6. The atomizing steam flow will vary as the oil firing rates vary.

Thus, the combustion system will maintain steam pressure by burning blast furnace gas with the correct fuel-air ratio.

* Inland Steel Co., East Chicago, Ind.

H. Goldberg, Pub. Serv. Co. Ind.; N. T. Weimer, S & C Elec.; C. E. Parks, Pub. Serv. Ind.; E. G. Norell, Sargent & Lundy

Gas Turbines in Nuclear Power Plants

By H. E. GRANTZ * and B. H. NEUFFER †

THIS PAPER reports the results of some academic studies of cycles involving gas turbines in combination with atomic power plants. These are general and not reported for any particular size power plant.

Three different types of reactors were considered in these studies. The first is the boiling water reactor of the type being developed by the Argonne National Laboratory of the Atomic Energy Commission. Second is a non-boiling type in which the heat is removed from the primary loop by means of a heat exchanger. Third is an air or gas cooled reactor. The study is based upon known characteristics of industrial gas turbines.

Plant performance and power costs are analyzed for: boiling water reactor and superheating gas turbine, 6.7 mills to as low as 6.1 mills per kwh; open cycle direct cooling, cycle efficiency up to 33 per cent at 1300 F; open cycle indirect cooling; closed cycle direct cooling.

1. The topping or superheating

* Manager, and † Power Plant Analyst, respectively, Atomic Power Plant Equipment, Engineering Sub-Section, General Electric Co.

Joseph G. Hayes, W. H. & L. D. Betz, Chicago; S. M. Day, Donald Foreman, and D. D. Clark, Central Illinois Lgt. Co.

Thomas E. Bell, of Republic Flow Meters Company, Chicago, and Ray C. Ascher, of Republic Flow Meters Co. in Detroit

POWER ENGINEERING camera teams covered Conference activities. Above Bob Mitchell, Assoc. Ed., and R. Marinello

The splendid mixed choir of the University of Illinois, led by Paul Young, gave added enjoyment to heavily-attended All Engineers Dinner in the Grand Ballroom

Representing Illinois Power Company at the Power Conference were W. J. Kelley, M. A. Fawcett, and G. E. Baker

C. R. Earle, POWER ENGINEERING, Chmn.; F. B. Banton, Cons. Eng.; M. L. Jones, DuPont, at Ind. Steam & Power Session

Another POWER ENGINEERING camera team consisted of Emil B. Skubik and Raymond Hagenmiller, Associate Editor

cycle apparently will permit increasing the output of a boiling water reactor to a marked extent for a modest increase in capital investment. This cycle will also satisfy the present temperature limitations of the reactor fuel elements. It permits operating the gas turbine independently at its optimum temperature.

2. The open cycle direct cooling is the simplest, least costly and the most suited of all cycles studied for installation in remote areas where transportability and simplicity are important. However, the problem of high fuel element temperatures must be solved before this type plant can be fully exploited.

3. The indirect cooled open cycle provides one means of preventing the accumulation of foreign air-borne contaminants in the reactor if this should be a serious problem.

4. In order to keep initial costs to a minimum, the first experimental considerations of gas turbines will probably be for small packaged power plants.

Cooling Towers for the Power Industry

By F. J. LOCKHART, J. M. WHITESELL and A. C. CATLAND, Jr. *

STEAM POWER PLANTS must have an ample, dependable, and economical supply of cold water. At one time enough cold water was supplied by nature in rivers, lakes, and other sources to be used on a once-through basis. However, water conservation regulations and anti-pollution legislation increase each year; less water is available, or it is more expensive, or at higher temperature. All industries using cooling water find a greater economic attraction in reusing cooling water over and over again. There is a definite increasing trend towards the use of cooling towers in steam power plants.

The design of a cooling tower from the performance viewpoint is a proper balance of many factors — the proper combination of contacting effectiveness, coalescing effectiveness, and horsepower requirements — all to result in the most economical tower.

The purchaser of a cooling tower wants to select the most economical unit, considering both initial investment and operating costs; i.e., a tower which will have a minimum of trouble and maintenance and a maximum of reliability over the anticipated life of the plant.

The proper selection of cooling towers, or any other purchased item, may be divided into three important parts: (1) Writing of specifications, (2) Evaluation of bids, and (3) Inspection and testing.

The specifications put in writing just what conditions are to be satisfied and what is expected of the cooling tower. Proper specifications also help ensure that the proposals will be submitted on a comparable basis, for ease of evaluation. On the other hand, the writing of too rigid a specification will also result in needless additional expense for the purchaser.

The evaluation of bids is the most difficult of the three parts in the proper selection of a cooling tower. After the purchaser has specified the circulating water rate, range, approach, and design wet bulb, the manufacturer has a number of design variables which will determine his selection.

Research and development programs are active on some current engineering problems to improve the design and operation of cooling towers. This is being done by the manufacturers for specific design problems and by the Cooling Tower Institute for general problems.

* The Fluor Corp., Ltd.

Photo subjects named l. to r. in all captions

Stack Behavior Under Wind Loading

By C. G. MERRIMAN and M. S. OZKER *

WHEN AN AIR STREAM flows about a cylindrical structure, such as a power plant stack, above a certain velocity the leeward wake is not stream-lined. In this wake will be found vortices of the pattern known as von Karman's Vortex Trail. The vortices are clockwise in plan on one side of the trail and counterclockwise on the other. They are shed alternately from each side of the stack in a regular manner and mark the occurrence of alternating lateral forces on the stack normal to the air stream. Vibration of stacks is the result of these periodic lateral forces.

Two types of motion resulting from this excitation have been observed. The first is the periodic ovalling or breathing of the stack, and the second is the oscillation of the stack as a cantilever in a plane perpendicular to the direction of the wind.

As the result of damage due to wind-induced oscillations of Detroit Edison's St. Clair stacks on November 26, 1952, certain design revisions were made. The question of whether the revised stacks, when completed, would be self-supporting under wind conditions prevalent in the area, as determined from statistically available data, could not be answered due to lack of information necessary to carry out a complete dynamic analysis of the stack structure.

In an effort to determine the structural damping, the actual natural frequency, and the deflection-stress relationship of the stacks in question, an experimental program was undertaken.

Prior to completion of the above tests, there was a lack of conclusive evidence to affirm the structural capability of the revised St. Clair stacks. This led to a search for measures to increase their stability. Since this can be achieved by increasing the energy dissipation capacity of the structure, a guy-damper device was recommended by Professor J. P. Den Hartog of MIT. The principle of this device is a parallel combination of tension springs and a hydraulic dashpot incorporated in a taut guy line. A prototype of this device was built and tested to determine its dynamic behavior.

The stack designer is in the need of additional information related to damping characteristics of various types of stack structures, and the magnitude of wind-induced exciting forces. Research pertinent to the latter item is underway and the results are expected to be available in the near future.

* The Detroit Edison Co.

New Excitation System Without Commutators

By H. W. CORY * and W. L. RINGLAND †

RELIABILITY and rapid speed of response have been the objectives in the development of a new excitation system for turbine generators by the authors' company. For a more complete description of this system than can be presented here, refer to POWER ENGINEERING, June 1954 issue.

The major advantages of the system lie in the construction of the inductor alternator used to generate the excitation power. The rotor of this machine has no windings, commutator or collector rings and is overhung on the main generator shaft.

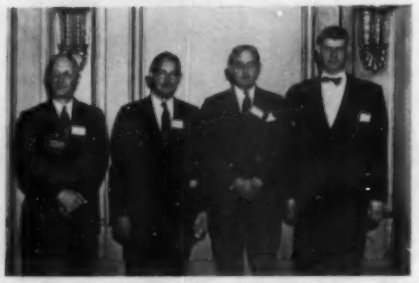
Unusually rapid speed of response is obtained through the use of magnetic amplifiers which control the exciter magnetization by absorbing reactive kva from the a-c exciter output. Changes in exciter voltage are accomplished as rapidly as the magnetic amplifier current can be changed. Over-all excitation system response is determined mainly by the small time constant of the magnetic amplifiers

* Chief Engineer, Control Engineering Section, and † Chief Engineer, Motor and Generator Section, Allis-Chalmers Mfg. Co.

Photo subjects named l. to r. in all captions

R. C. Oliver, Jr. and T. C. Hope, Black & Veatch, with H. A. Grabowski, C-E New York, H. Ongman, C-E Chattanooga

Chmn. W. P. Green, speakers Anderson and Chao, and Assoc. Chmn. Ibele discussed gas turbine developments



Chmn. Solberg (Purdue), Dr. Ulmer (C-E), Wilcoxson (VP, B & W), and Assoc. Chmn. Kanter (Crane) discussed boilers

Gaining additional technical background for his duties as Art Director of the POWER ENGINEERING editorial staff, Jim Wilcox listened in on several sessions

The first two "Match-your-tag" winners G. E. Klapper (Phil. Elec. Co.) and K. S. Austin (Lake Superior District Power Co.) who picked screw driver set and trivet

H. R. Cowles (Otter Tail Power Co.) and W. Van Tassel (Montana-Dakota Power Co.) swap some notes. Van Tassel has charge of a unique gas turbine station

rather than the usually-substantial time constant of the conventional exciter field.

Tests of this new system with a 40,000-kva generator demonstrate extremely rapid initial response. The test generator used has an open circuit time constant of 10 sec. With sudden application of about 45 per cent load at 20 per cent pf above no load, the terminal voltage was restored in just under 40 cycles.

During this same test, the voltage across the generator field (exciter output voltage) reached a ceiling voltage of at least three times its initial value within eight cycles after load application. The generator field current was increased to that value required to sustain the load at the initial voltage in 25 cycles after load application.

Combined Steam-Gas Turbine Plants

By W. B. WILSON *
and A. A. HAFER †

IT IS NOT now economical to reduce the stack temperature of the gas turbine unit down to the levels attained in steam plants (300 to 400 F). Therefore, it is logical to consider means of combining the gas turbine with the steam plant to realize these low stack temperatures. The following are various ways of effecting this combination:

1. Using the gas turbine exhaust to heat feedwater for the steam plant;
2. Using the gas turbine exhaust to generate steam in an exhaust heat recovery boiler;
3. Using the gas turbine exhaust as highly preheated combustion air for the boiler since it still contains over 80 per cent of the original oxygen;
4. Using the gas turbine compressed air in a supercharged boiler system with the exhaust of the gas turbine preheating the feedwater and/or the compressed air.

If the above combinations are effected properly, the efficiency of the combined plant will always be higher than either the steam cycle alone or the gas turbine cycle alone. Where the gas turbine exhaust is used to heat the feedwater, this arrangement will replace feedwater heaters or economizer surface normally associated with the steam plant. In the case of the cycle in which the gas turbine exhaust is used in an exhaust heat recovery boiler, the steam generated may be used for either process or power uses. Experience indicates that the gas turbine, with an exhaust temperature of 840 F, can generate steam economically up to a temperature of about 750 F in an exhaust heat recovery boiler.

The efficiency of these combined plants is higher than either the gas turbine cycle or steam cycle individually since the cycle has been modified so that work is obtained from the combustion gases without a corresponding increase in the power plant losses.

The authors predicted that, in the future, gas turbines will be used in a number of different types of combined steam-gas turbine plants. In the older medium-size steam plants (20,000 to 100,000 kw), simple-cycle gas turbines will find use with the exhaust used either to heat feedwater, or as highly preheated combustion air for the boiler. If boiler capacity is a limiting factor, the exhaust will be utilized for feedwater heating; whereas, if steam-turbine capacity is limiting, the gas turbine exhaust gas will be used as combustion air for the fuel-fired boilers. Gas turbines will be used to drive boiler feed pumps or generators in large central stations (150,000 kw or larger), with the exhaust either heating feedwater or being used as combustion air in the boilers. In gas-burning steam plants, the flow-gas turbine combination is attractive with the exhaust also used as boiler combustion air.

For new medium-size steam plants, the gas turbine will provide all of the boiler combustion air or supercharge the boiler. In the larger new steam plants, the gas turbine will play an important future role in the supercharged boiler plant.

* Manager, Power Generation Engineering, Ind. Eng. Sect., General Electric Co., † Manager, Product Planning & Marketing Research, Gas Turbine Dept., General Electric Co.

R. H. Bacon (Bacon & Co.), J. N. Wognum (Acme Steel), and C. N. Parsons (Republic Flow Meter) between sessions

J. Trainer (VP, PSC of Ind.), R. M. Beville (Westinghouse), H. Goldberg (PSC, Ind.), and E. G. Norell (Sargent & Lundy)

Charles Kiel and E. C. Duffy (Long Island Lighting Company, Mineola, N. Y.) with David B. Sloane (Gibbs & Hill of N. Y.)

A. H. Kuhn and A. C. Bull, both Vice Presidents of Pioneer Service and Engineering Company (Chicago, Illinois), were part of the highly-talented attendance

R. W. Precious, J. W. Trull and R. S. Potts, all connected with the Union Carbide and Chemical Corporation, get together on the mezzanine of the Sherman

Andrew W. Kramer, well-known Editor of POWER ENGINEERING, acted as Associate Chairman of session on progress in technology of nuclear power generation

Atomic Energy Forum Evokes Great Interest

EMPHASIZING the growing general interest in atomic energy, more than 1000 people crowded into the Grand Ballroom on Mar. 30 to attend the Evening Forum on Industrial Development of Atomic Energy. Chairman was T. G. LeClair, Engineering Assistant to the Vice President, Commonwealth Edison Company, Chicago, and the Moderator was the Honorable Bourke B. Hickenlooper, United States Senator from Iowa and Member of the Joint Committee on Atomic Energy, Washington, D. C.

Panel Members were: Arthur S. Griswold, Assistant to Walter L. Cisler, President of the Detroit Edison Company, who was unable to be present (Mr. Cisler represented the Atomic Power Development Associates); Philip Sporn, President of American Gas and Electric Service Corp., who represented the Nuclear Power Group; William Webster, Executive Vice-President, New England Electric System and President, Yankee Atomic Electric Co., and James F. Fairman, Vice President in Charge of Engineering, Consolidated Edison Co., N. Y.

In response to the Jan. 10, 1955 announcement by the Atomic Energy Commission of a Development Reactor Program, each of the groups represented was submitting plans for an experimental nuclear power plant.

The proposed plants will vary from 100,000 to 230,000 kw, and each panel member emphasized that the purpose of these plants was to gain operating experience and know-how, that they had no illusions that the reactors they were considering would be the last word in reactor development, but they were confident that they would be making real contributions to the development of nuclear power.

Some of the remarks of William Webster, President of Yankee Atomic Electric System, seemed to represent the general attitude of the members of the Forum. "Our basic objective," he said, "was an atomic power plant which could be designed on present information for prompt construction. While some more advanced kinds of reactors perhaps hold the brightest promise for the future, we feel it is important to parallel research in such fields with the actual building and operation of a simpler type which can be pushed ahead immediately."

Though Mr. Webster was speaking for his own group and for New England, his remarks could apply equally well to the other groups and to any part of the country, and they reflect the energetic way in which the utilities are going ahead with the development of nuclear power for industrial use.

For more abstracts of APC papers, turn to page 127.

Photo subjects named l. to r. in all captions

Bull session in our Hospitality Suite: Bob Mitchell (POWER ENGINEERING), W. Bokus (Mo. Sch. of Mines), T. Heil (S. D. Sch. of Mines), Paul Grogan (back to camera, UW), J. E. Blair (IIT), R. D. Merrill (Stone Container), C. Earle (POWER ENGINEERING)

Andy Anderson, Norman Jones, Assoc. Editors, act as photographers to help cover sessions for POWER ENGINEERING

Bob Coates (S. Morgan Smith Co.) talks it all over with John Steig (Rhinelander Paper Co.) outside the Grand Ballroom

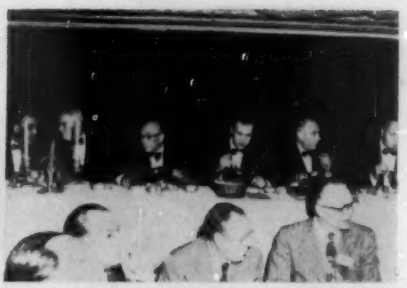
J. J. Trainer and M. L. Cornelius, both of Riley Stoker Corp., in convention lobby

E. B. Skubik and Eugene Zucker (POWER ENGINEERING) take pictures and notes

Head table men, All-Engineers Dinner: Fischer Black, *Electrical World*, presiding; J. T. Rettaliata, president, IIT; Alexander M. Beebee, president, Rochester G & E; A. A. Potter, BCR; R. A. Budenholzer, Conf. Dir.; E. R. Whitehead, Sec.

F. G. Straub of the University of Illinois confers on water problem with Glenn R. Fryling, associate editor, *Combustion*

Ed Schultz, George Kueltemeyer, and Walter Siren, all from the City of Milwaukee Boiler Inspection Division



At All-Engineers dinner: Ben G. Elliott; J. Sullivan; D. W. R. Morgan, ASME; J. T. Rettaliata; A. M. Beebee; Fischer Black

R. L. Bishop, Commonwealth Edison; J. A. Bellington, Refractory and Insul. Corp.; N. A. Kershaw, Commonwealth Edison

T. Sawyer, E. Armstrong, E. Dahlund, K. Bower, L. Brinson, A. Hoffman, R. Flugum, session on automatic equip.

Chas. M. Hardin, of Chas. M. Hardin Co.; F. Faville of Faville-LeValley Corp.; A. C. Bull, Pioneer Service & Eng. Co.

H. C. Farmer, Chief Chemist, Phil. Electric Co. and V. J. Calise, Dir. of Research, Graver Water Conditioning Co.

J. E. Stevens, of Edward Valves, Inc. of East Chicago, Ind. and D. M. Mills of the Stearns-Rogers Mfg. Company

Col. D. F. Lehnhard, Chief, Maint. Div. USAF; C. R. Earle, POWER ENGINEERING; G. A. Grimm, Office of Sec. of Defense

R. F. Born and C. E. Morrow, Western Electric; C. R. Earle, POWER ENGINEERING; E. F. Rothemich, Riley Stoker Corporation

R. F. Stellar, St. Lawrence; D. S. Jenkins, Salt Water Convrsn.; W. Drescher, U. S. Geo. Survey; R. Pafford, Corps of Engrs.

M. L. McClure, E. I. DuPont de Nemours & Co., Inc., Clinton, Iowa, at the General Electric nuclear power plant model

Prize numbers were distributed by Mildred Novosel, Dolores Roscoe, Marian Heniken, Marjorie Weissman, and Mara Vamos of POWER ENGINEERING'S staff

H. F. Bachmann, Sinclair Refining Co.; M. E. Wells, also of Sinclair Refining, and J. M. Maloney, Hall Laboratories, Chicago, get together for discussion

Fig. 1. Lakeland Village treatment plant. Digester tank is readily distinguished by the cylindrical black gas collection chamber in the center of its floating cover

Heat Pump Goes to Work in Sewage Treatment

Subject of many recent studies, the heat pump has ventured into a new field — sewage treatment. Analysis of plant requirements and electric rates may reveal that use of a heat pump can effect important economies

By M. A. MINISH*

Fig. 2. The heat pump installation at Lakeland. Note simplicity of assembly

IN THE PROGRESSIVE development of sewage treatment and disposal methods, there have been but few pieces of equipment that have been designed and developed solely for the purpose of treating sewage. Most such equipment now utilized is an adaptation of equipment already developed for use by industry for similar purposes.

The Heat Pump is a tried and proven system of heating, and, although it has not been adapted to heating within the process of sewage disposal until recently, it has many advantages over presently accepted heating systems which warrant its acceptance by designers and operators of sewage treatment plants.

It is apparent that there is a growing concern nationally with respect to the extensive amount of municipal refuse that is disposed of as complete waste instead of making some attempt to salvage valuable by-products. In the field of sewage disposal, considerable work has been carried on in an attempt to salvage sewage sludge for practical use and to convert sewage gas to mechanical energy or heat within the sewage treatment plant. The use of the heat pump within a sewage treatment plant can increase the efficiency of the plant and add another step toward a more complete utilization of municipal waste.

"Heat pump" is a name usually used to designate refrigerating equipment which is utilized for heating purposes. Heat is absorbed from a heat source ordinarily too low in temperature for the usual heating methods into a refrigerant that is at an even lower temperature. The refrigerant, with this absorbed heat, is then compressed into a much smaller volume at a higher pressure, resulting in a high-temperature gas or liquid containing the same *quantity* of heat (provided that no heat was added or lost in the process).

The advantage to be gained when using this method of heating is best expressed by a ratio called the "coefficient of performance," or C.O.P. This is the ratio of the heat delivered for useful purposes to the heat equivalent of the electrical or mechanical energy used in the process. Practically all of the electrical or mechanical energy used in the process is also converted into heat. The major portion of this energy added to the refrigerant is the mechanical heating of compression; the remainder is the heating due to windage and friction of the rotating parts, and the resistance heating in motor windings when an electric motor is used. By care in design, all, or nearly all, of this converted heat energy can usually be channeled into the useful heat stream. Thus, the useful heat delivered will always be greater than the heat equivalent of the energy used for the process, and the C.O.P. will be greater than unity. In most cases, it varies from 2 to 5, but in unusual cases may be as great as 7 to 10 or more.

Other conditions being equal, the C.O.P. of a heat pump increases as the difference between the temperature of the useful heat and the temperature of the heat source approaches zero. Since comparatively

*Hill & Ingman, Consulting Engineers, Seattle, Wash.

large quantities of sewage pass through a sewage treatment plant, and much of the waste water originally entered in a somewhat heated condition and was carried underground until it arrived at the plant, the temperature of the incoming sewage is usually 50 F or above. With the ideal digester temperature of 95 F, the resulting difference in temperature is favorable for a C.O.P. of 3 to 5. In most cases, withdrawal of sufficient heat from the total incoming sewage for digester purposes would lower the sewage temperature less than 1 F. This change in temperature should have no effect on the aeration and clarification processes.

The first heat pump unit to be used in a sewage treatment plant for the purpose of heating the digester is at the Lakeland Village Treatment Plant (Fig. 1) a State of Washington institution not far from Spokane, Washington. The plant is a primary type plant with preaeration. It is designed for a population of 1600 people with an average flow of 300,000 gallons per day. In designing this treatment plant, the engineers based their selection of the heat pump, as a means of heating the digester, on the following:

1. Low cost of electrical energy. The State of Washington enjoys a very favorable contract for supplying electrical energy to this hospital.
2. Past experience has shown that competent service in small communities for other types of automatic heating systems is difficult to obtain. However, in most communities, there are competent service companies on refrigeration equipment.
3. The compactness and neatness of the unit made it possible to house it in a smaller space with less objectionable conditions encountered during operation.

The heat pump, Fig. 2, was designed around standard equipment. The compressor is a Tecumseh Model V.F.P.W. 300H, driven by a 3-hp, 3-phase, 220-v motor. The condenser, mounted just above the compressor unit, is a Wix 2-pass type having a shell 7 ft long and 10 in. in diameter with three 3-in. tubes through which the sludge is circulated as it is pumped from the digester through the condenser and back to the digester. With the hot, compressed freon in the 10-in. tube and around the 3-in. tubes, heat readily flows through the walls of the sludge tubes to heat the circulating sludge. Sludge circulation is accomplished by means of a 2-hp centrifugal pump in the pit below the compressor room.

Heat for the digester is obtained by passing the cold refrigerant into three 22-in. by 60-in. Dole quick-freeze plates mounted in the hydro-wash tank (aerated grit chamber) in such a manner that the agitated sewage flows quite rapidly along the plate surfaces, thus providing good heat transfer. The compressed liquid freon is fed to each plate by a separate thermostatically controlled expansion valve. A schematic diagram of the system is shown in Fig. 3.

Since digester heating is to be accomplished by the use of electrical energy, the digester was well insulated thermally. The exceptionally low digester heat losses found in tests provide evidence of the value of this construction. Such heat insulation might be advisable regardless of the method of heating.

Before designing the heat pump for this plant, the engineers consulted George S. Smith, Professor in Electrical Engineering at the University of Washington, who is an authority on Heat Pumps.[1] Not only was Mr. Smith helpful in the design of this unit, but he was instrumental also in setting up, recording and reporting the tests taken on this plant. During the time of construction of the plant, Mr. James A. Morris, Jr., was working on his Master of Science degree in Electrical Engineering at the University of Washington. Prof. Smith interested Mr. Morris in writing his thesis on the heat pump as it pertained to this plant. This resulted in an extensive testing program which could not have been carried out without such time, technical ability and equipment as was made available for this study.[2]

The results of this study have made it possible to evaluate more accurately the future use of the heat pump in the sewage treatment industry. Various coefficients used in our original design were either substantiated or we were provided with new coefficients supported by operational data. The heat loss computations and the value of the digester insulation, as previously mentioned, were substantiated. Operational costs were provided as well as C.O.P. values for use in future design.

The heat pump can be used to an advantage in sewage treatment plants depending upon the plant size and the over-all design of the plant.

In small plants, too often the gas production is insufficient to supply the boiler or sludge heater at the minimum rated burner capacity of the boiler. Oil or other fuel must be used as an auxiliary. *Turn page*

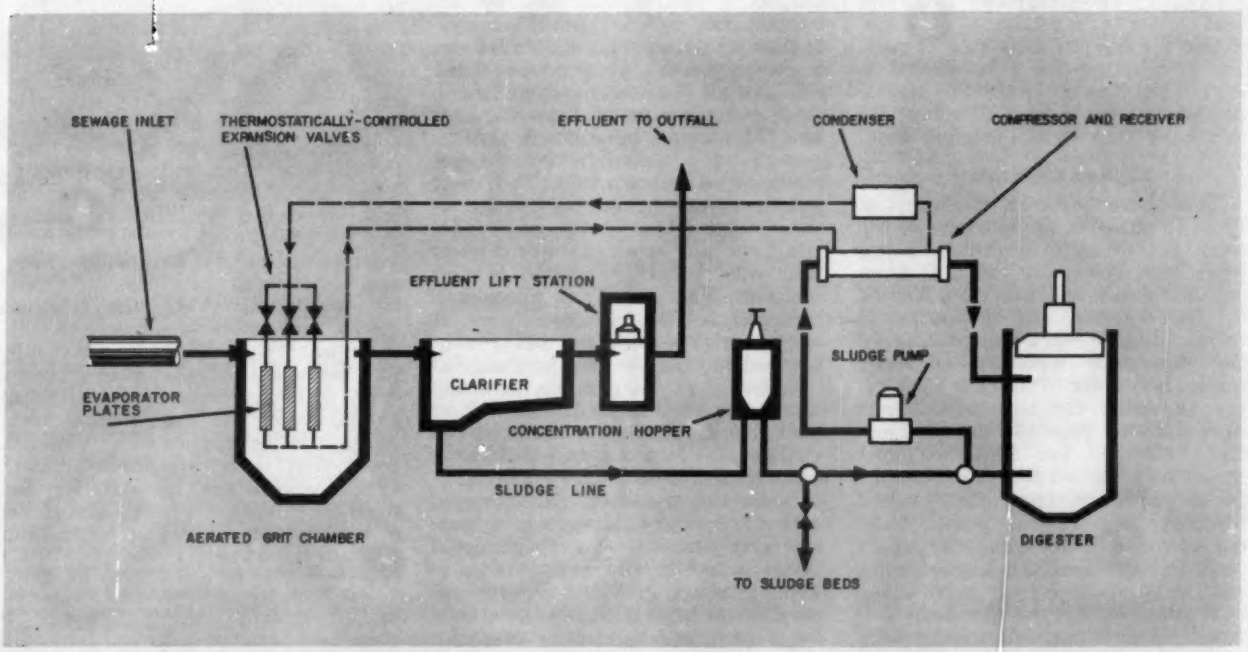


Fig. 3. Simplified flow diagram of sewage treatment plant at Lakeland Village, Wash. Some pumps are actually paired

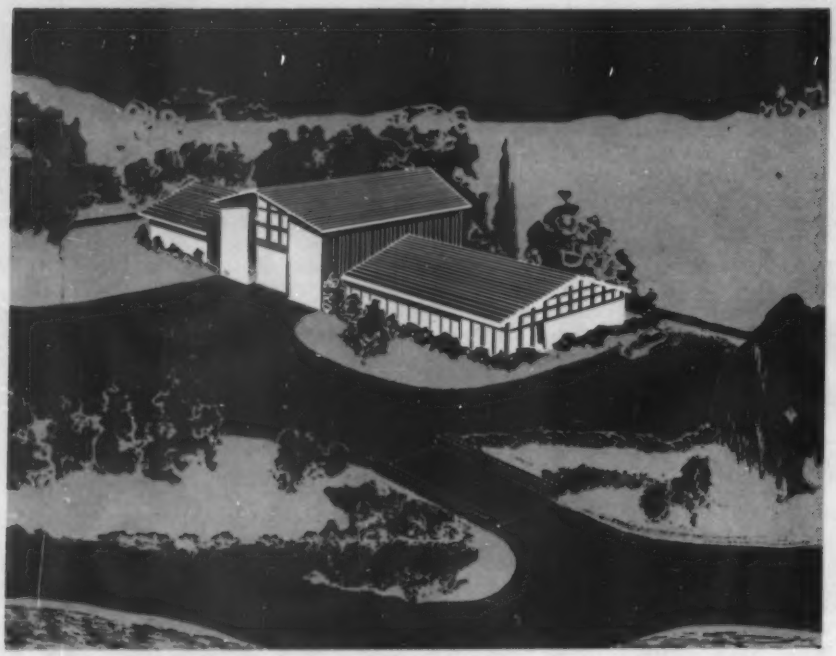


Fig. 4. Design for a sewage treatment plant to be located in a residential area. Architectural treatment and proper landscaping remove objectionable features

Heat Pump . . . . *(continued)*

In such instances it may be shown that the heat pump could be installed and operated at less cost, over a short period of time, than the cost of the auxiliary fuel.

In large plants in areas where steam or oil generation of electricity must be relied upon, it may be shown that it is economical to utilize all the sewage gas to generate electrical power for use within the plant and use a portion of the generated power to run a heat pump. Approximately 50 per cent of the original heat in the gas can be salvaged by using the heat in the exhaust gases of a gas engine for digester heating. Regardless of whether the exhaust gas is used or not, the generator will deliver the energy equivalent of about 20 to 25 per cent of the original heat.

Higher Efficiency

This means over-all efficiency of 70 to 75 per cent, far in excess of the usual generating of electrical energy from heat. Normally the heat from exhaust gases will not be sufficient for the digester, and a portion of the gas is burned in a boiler to supply the remainder with an efficiency rarely in excess of 60 per cent. If the gas used for this added heat were used to generate electrical energy, only 10 per cent less heat would be obtained from the exhaust gas and added electrical energy would be provided. A heat pump could use a portion of this energy to supply three to four times its heat equivalent and thus easily supply any added heat required by the digester. This would result in more electrical energy to use elsewhere.

In many cases a sewage treatment plant must be built where drying of the digested sludge on sand beds is not possible or practical. This could be due to high cost or unavailability of land, poor drying conditions during many months of the year, or for other reasons. In such cases, digested sludge must be disposed of by other means. This is commonly done by vacuum filtering the sludge and disposing of the filter cake by various means, such as using it as fill or selling it to a commercial fertilizer company. In many instances, it is dried and sold by the municipality for soil conditioner or fertilizer. Of course, it would be more profitable to produce dried sludge if all the heat required by the dryer were to come from digester gas. This could be done if the digesters were heated by some other means than sewage gas. The most practical way would be by use of the heat pump.

Let us take as an example a plant that was recently designed in this manner (Fig. 4). This plant was designed for 35,000 population. It was the wish of the municipal governing body to use the sewage sludge as fertilizer if at all possible. A study was made of the gas production vs heat required to dry vacuum-filtered sludge cake. It was assumed that the plant would be skillfully operated.

Since the treatment plant would serve a residential section, a considerable amount of garbage could be expected in the sewage due to home garbage grinders. Sewage gas production from such sewage should be above normal. As an average for primary type treatment plants such as that under discussion, a fair estimate of gas production would be 0.75 cubic feet per capita per day. Therefore, the gas production would be approximately 26,000 cu ft per day.

The amount of water that must be evaporated depends upon the quantity and moisture content of the sludge cake from the filter. The quantity of sludge from the filter was estimated at approximately 11,500 pounds per day at 70 per cent moisture. If the sludge was dried to 12 per cent, which is considered adequate for bagging purposes, the amount of water evaporated would be approximately 7600 lb per day.

A commercial dryer can be expected to dry such material, using sewage gas at a value of approximately 700 Btu per cu ft, at approximately one pound of water for every 2.7 cu ft of gas. Therefore, the gas necessary per day would be 20,500 cu ft, which is less than that expected from the digester.

In comparison, the same commercial dryer can be expected to use approximately 0.012 gallon of oil per pound of water evaporated. Therefore, to evaporate the equivalent amount of water would take 91 gallons of oil per day. With oil at 14 cents per gallon (Puget Sound prices) the cost of drying per day would be $12.74, or roughly $4650 per year.

The cost of heating a digester with the heat pump will vary with the amount of heat loss, the C.O.P. of the heat pump, and the cost of electrical energy. The heat loss was considered to average approximately 183,000 Btu per hr for the year.

C.O.P. of Heat Pump

The C.O.P. of the heat pump was considered to be three and the electrical energy cost would be 5 mills per kw hr. This figures to be $2.14 per day or $780 per year.

Therefore, assuming that the sludge must be dried, a saving of $3900 per year can be realized by using the sewage gas to dry the sludge instead of heating the digester, and employing a heat pump to heat the digester. This will very quickly offset the difference in equipment cost between a conventional heater and the heat pump.

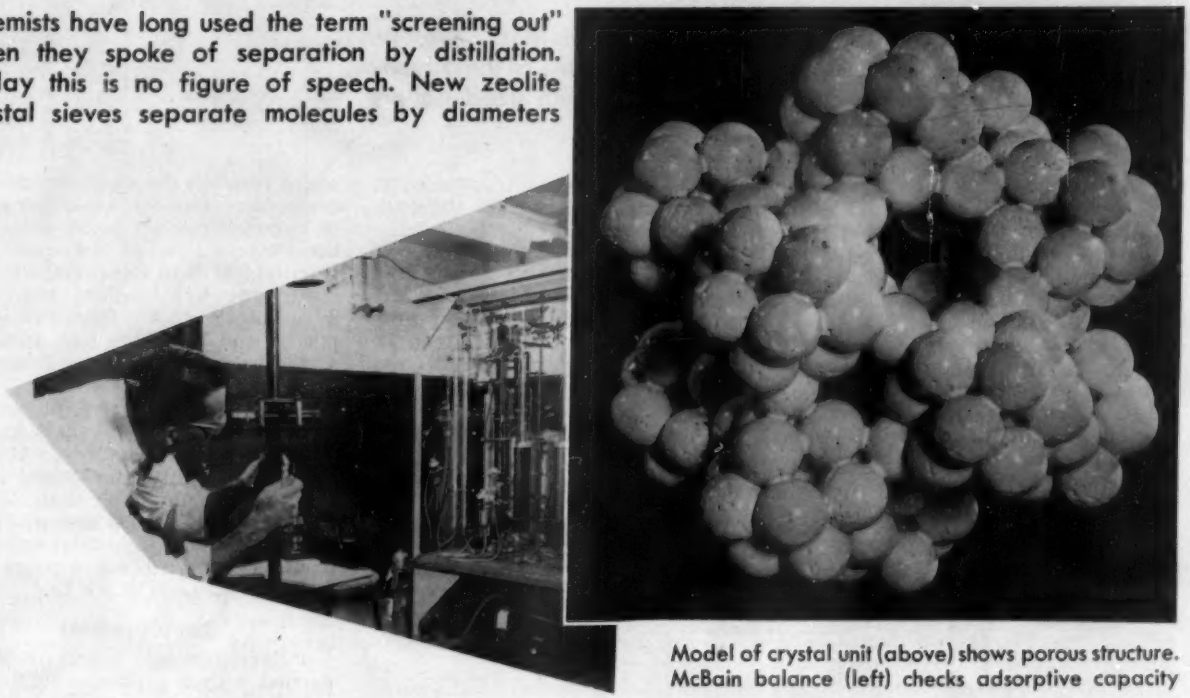
More operational data will be necessary before any definite facts can be established as to the relative merits and operational savings accomplished by using the heat pump in a sewage treatment plant. However, with the vast amount of data available on the use of the heat pump in other applications, it would seem that design engineers could, in many instances, adapt it for use in sewage treatment plants and show a considerable saving in operating costs to the owner.

[1] *The Heat Pump for Residential Heating*, by George S. Smith, Harvey Christensen and Arthur Presson, Univ. of Wash. Engineering Experiment Station.

[2] *Use of the Heat Pump for Digester Heating*, by George S. Smith and James A. Morris, Jr., Univ. of Wash. Engineering Experiment Station.

New Zeolites Separate Gas or Liquid Mixtures by Molecule Size

Chemists have long used the term "screening out" when they spoke of separation by distillation. Today this is no figure of speech. New zeolite crystal sieves separate molecules by diameters



Model of crystal unit (above) shows porous structure. McBain balance (left) checks adsorptive capacity

TWO SELECTIVE adsorbents, just announced by Linde Air Products, now provide industry with a completely new basis for the separation of mixtures of liquids *or* gases. Called molecular sieves, these materials are manufactured crystalline zeolites.

What makes them unusual is their ability to adsorb molecules below a certain diameter, and pass all molecules which are larger. Prior to this development, gas mixtures which were to be separated were first liquefied and then fractionally boiled off under controlled temperature and pressure — unless they were reacted chemically with high-affinity materials. Now they may be "screened out" of a mixture, and later separated from the adsorbent by heating. The same principle applies to the separation of liquids or gases.

These sieves are heated during manufacture to drive out the water of hydration. The unique nature of the material prevents its collapse under heating, as other zeolites would do. A porous crystalline structure remains, and it contains millions of cavities which are interconnected by millions of pores of extremely uniform size. Only the interior surfaces of the cavities are adsorptive, hence only those particles (molecules) small enough to pass through the pores will adhere to the crystal.

Gas drying is one of the leading industrial processes forecast for molecular sieves. They can improve the efficiency of this process since they have a high tenacity for water vapor, plus a high capacity and a high rate of adsorption. These properties result in a more thorough drying while permitting the use of smaller, less expensive equipment.

Another potentially large use for these materials is the drying and purification of liquids. It is extremely difficult (and sometimes impossible) to separate two liquids by distillation if they have near-identical boiling points. As long as one of the molecular structures is small enough to pass through the pores of one of these sieves, however, the liquids can be separated by adsorption. The sieves can also be used for the simultaneous adsorption of other impurities along with water if that is desirable.

Special Affinities

Besides size selectivity, molecular sieves show a marked affinity for both polar and unsaturated molecules. This attraction is so pronounced that they will adsorb polar or unsaturated molecules in preference to non-polar or saturated molecules of the same size. This feature could find application in the purification of gases and liquids, and in the reclamation of useful materials from waste gas streams.

Of particular interest to the power engineer is the high adsorptive capacity at high temperatures. For example, molecular sieves will adsorb water vapor at temperatures as high as 212 F — something no other adsorbent will do effectively. This makes it possible to dry gases at this temperature rather than pre-cooling the gas. Another result of this strong affinity for water is that they can super-dry gases to dew-points below minus 100 F.

Other types of applications may be possible for this new material, and at least one experimental application shows promise.

Simple Regeneration

Heating and purging comprise the regeneration process for these materials. They may be used repeatedly without "wearing out," which means that they may be used in continuous cyclic processes.

Molecular sieves are being manufactured in two sizes now. The "size" refers to the diameter of the pore opening, which is four Angstroms (16 billionths of an inch) for one material and 5 Angstroms (20 billionths of an inch) for the other. Both pore sizes are available in powder form or in pellets of ⅛- or 1/16-in. diameter.

These materials are important to the power engineer because of the uses he may be expected to make of them, and also because of their effect on power consumption in chemical distillation plants.

Jot "ZEOLITE ADSORBERS" on the post-card in this issue for more information on this material

Are Cyclone Furnaces Suitable for Small Boilers?

Though most cyclone furnaces today are in large boilers, development work was carried out in small units. Here are some of the advantages of using cyclone furnaces in small and medium sized boilers

By W. I. COLLINS*

PURPOSE OF this article is to point out the possibility and advantages of applying the cyclone furnace to small and medium-size steam generating units.

The cyclone furnace, as shown in Fig. 2, is essentially a horizontal water-cooled cylinder. The coal particles, fed in one end with a small amount of primary air, are thrown out against the inside surface. Secondary air, applied tangentially at high velocity, sweeps over the coal, providing rapid and complete combustion. There is a high collection of ash, which is tapped off in a molten state and flows into a tank of water where it disintegrates into a granulated slag. Gas and oil also can be burned in the cyclone furnace by shutting off the one fuel and then turning on the other.

To establish a frame of reference, we may define a small unit as one which employs the smallest presently designed cyclone furnace either in one or two cyclones per boiler unit. This then would bracket the small unit from 60,000 lb to about 200,000 lb of steam per hr; medium size units from 200,000 to 400,000 lb of steam per hr and the large size units upwards from 400,000 lb of steam per hr.

By the middle 1930's, pulverized-coal firing for power boilers had received wide acceptance. It had largely supplanted underfeed-stoker firing for boilers larger than 250,000 lb of steam per hr. It also was being applied to many industrial and small utility boilers in the size range from 50,000 to 250,000 lb per hr.

Development

Pulverized-coal firing, however, carried with it problems such as fly ash discharge; the need for large and costly ash precipitating and handling equipment; high maintenance on coal preparation equipment; erosion of fans and other machinery; limitation on grades of coal; excessive size of furnaces to avoid slagging and similar difficulties.

With these facts in mind, the author's company decided to devote considerable research effort to the development of a method for the efficient combustion of crushed coal and the collection of a large percentage of the ash in liquid form in the bottom of the furnace.

Several years of work followed in our laboratory at Barberton, Ohio,

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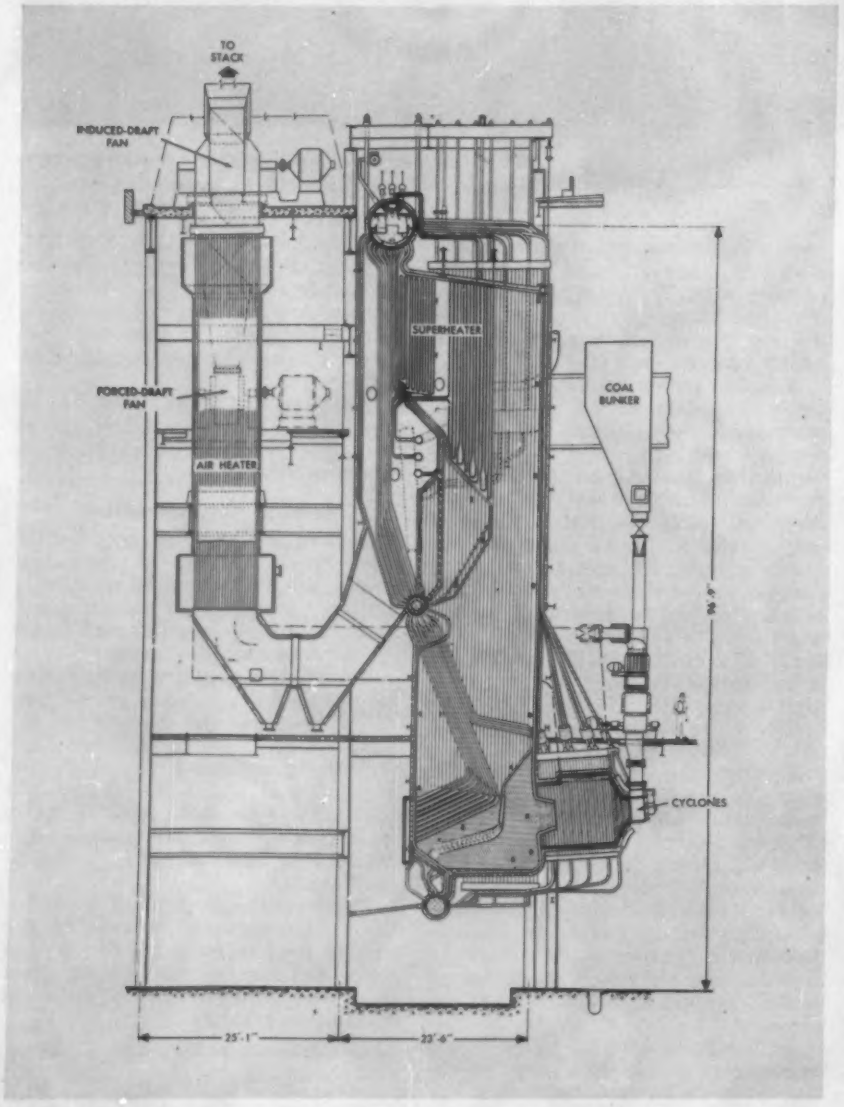


Fig. 1. Most of development work on the cyclone furnace was done on this 180,000 lb per hr, 350 psi boiler at the Calumet Station of Commonwealth Edison Company

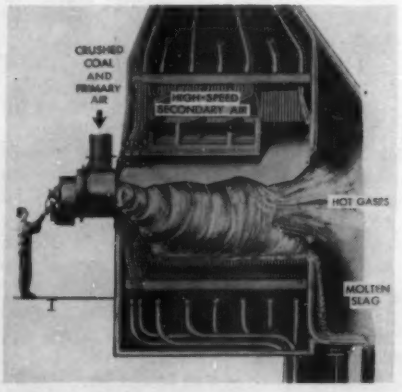


Fig. 2. Above. Main elements of cyclone furnace used in boiler in Fig. 1.

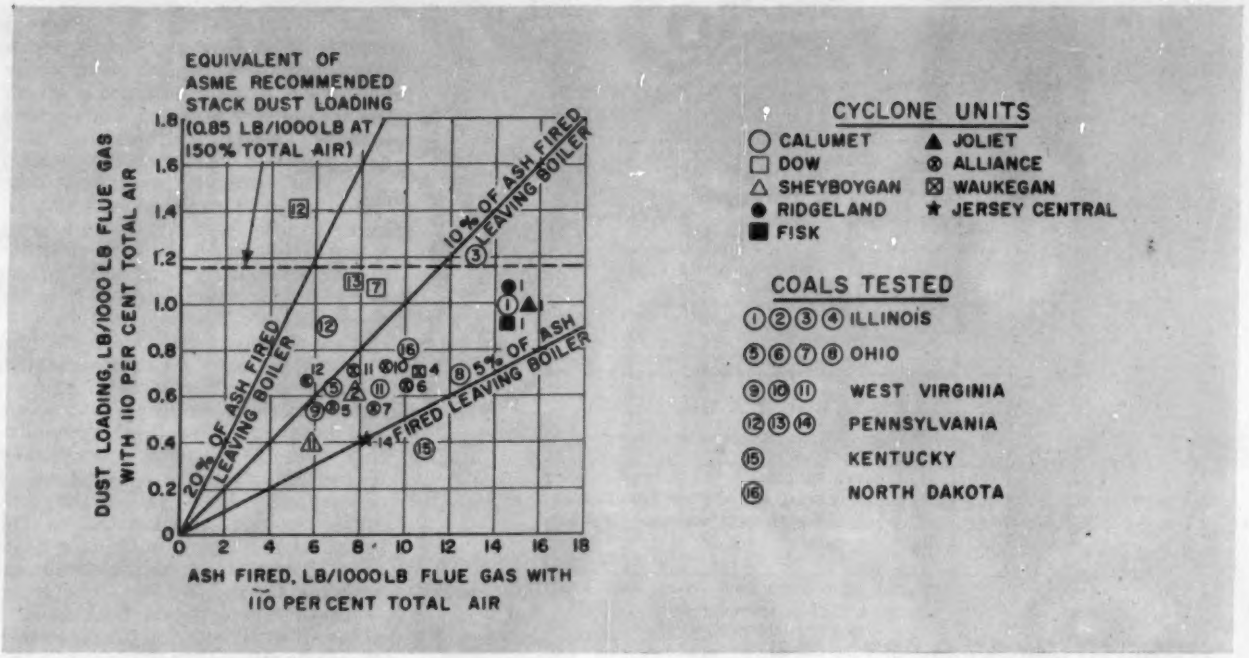


Fig. 3. Fly ash emission tests for several types of coal for use in cyclone furnaces in a number of central station boilers

including experiments with 1-ft and 3-ft-diameter cyclone furnaces, both in vertical and horizontal positions. Finally, a 5-ft-diameter horizontal cyclone unit was constructed for extensive testing. The boiler unit had a capacity of 60,000 lb of saturated steam per hr at atmospheric pressure. This cyclone could burn approximately 3 tons of coal per hr, and the unit was pressurized.

The results obtained from this first small cyclone unit permitted the design and fabrication of the unit for Calumet Station of the Commonwealth Edison Company. The Calumet unit consists of a Radiant type boiler with superheater, tubular air heater, and an 8-ft-diameter cyclone furnace having an output of approximately 180,000 lb of steam per hr at 350 psi, 650 F when burning approximately 13 tons per hr of 10,000-Btu-per-lb Central Illinois coal. Figure 1 shows the details of this installation. From the initial start-up, the Calumet unit was successful from the important points of efficiency, low stack emissions, safety and flexibility. It was from this first commercial cyclone-furnace boiler unit that operating data were obtained which made possible subsequent units whose capacities now range over 1,550,000 lb of steam per hr at 2125 psi, 1055 F and 1005 F reheat, corresponding to a fuel-burning rate of 100 tons of coal per hr.

As interest in the cyclone furnace grew and it became desirable to test a wide range of coals, it was decided to build a pilot unit at B&W's Alliance, Ohio, Research Center. This unit was designed for atmospheric operation and consisted of a 2-ft-diameter cyclone furnace, a water-cooled secondary furnace, and a preheater capable of supplying air at temperatures from 450 F to 1000 F. The heat capacity as measured by fuel input was approximately 15,000,000 Btu (1200 lb of eastern coal) per hr. This small research cyclone furnace has been used to determine suitability of coals and other fuels for cyclone furnace operation.

It is apparent from the foregoing that all of the early development work on cyclone furnaces was conducted on units whose steam-generating capacity or heat input comes within the definition of a "small or medium-size" unit.

Suitability of Coals

Major studies have been undertaken to determine the range and type of fuels which can be fired in the cyclone furnace. This is most important since the policy of the author's company is to offer cyclone furnace units only when the long-range fuel supply has characteristics closely similar to fuels which have demonstrated by trial their suitability for cyclonic firing. These studies have shown that the most reliable fuel characteristics which can be used to determine the suitability of coal for cyclone furnaces are the amount of volatile matter, the slag viscosity, and the ash-softening temperature.

Fig. 4 shows results of tests conducted on various Pennsylvania, Northern West Virginia and Ohio coals. It will be noted that a large majority are in the "satisfactory" category.

Approximately 70 per cent of the 512 million tons of bituminous and lignitic coals mined in this country in 1950 would have been suitable for use in cyclone furnaces. It is evident, from tests and surveys, that regardless of where cyclone furnace boilers are installed, they should be in an excellent competitive fuel market. Generally, the fuel characteristics that have been proven best suited for cyclone furnaces are found in the lower grade and cheaper coals. Many pulverized-coal-fired boilers are designed to burn these same low grade coals, but often they are not as economical to burn as the more expensive higher grade coals because of high pulverizer power, high pulverizer maintenance, ash-handling and disposal, and induced-draft-fan maintenance. Thus, the purchaser of coal for pulverized-coal-fired boilers must exercise great care in fuel selection; and the available supply of the type of coal usually considered desirable for hopper bottom, dry ash, pulverized-coal-fired furnaces — high grindability, low ash content, and high fusion temperature — is diminishing.

In sections where oil and gas are basic fuels, the future coal reserves are particularly well suited to use in cyclone furnaces. Because of this, considerable thought is being given to the possible installation of cyclone furnaces for initial oil and gas firing and future coal firing.

Advantages of Cyclone

The performance of the cyclone furnace has made possible better functional designs of boilers, improved operating conditions, and reduced the problems of air pollution. These advantages have been obtained with reductions in both capital and operating costs. Specifically, there are a number of features or performance characteristics that point directly to certain advantages:

1. The cyclone furnace can handle a wide variety of coals and can easily be equipped to fire liquid and gaseous fuels. *continued on the next page*

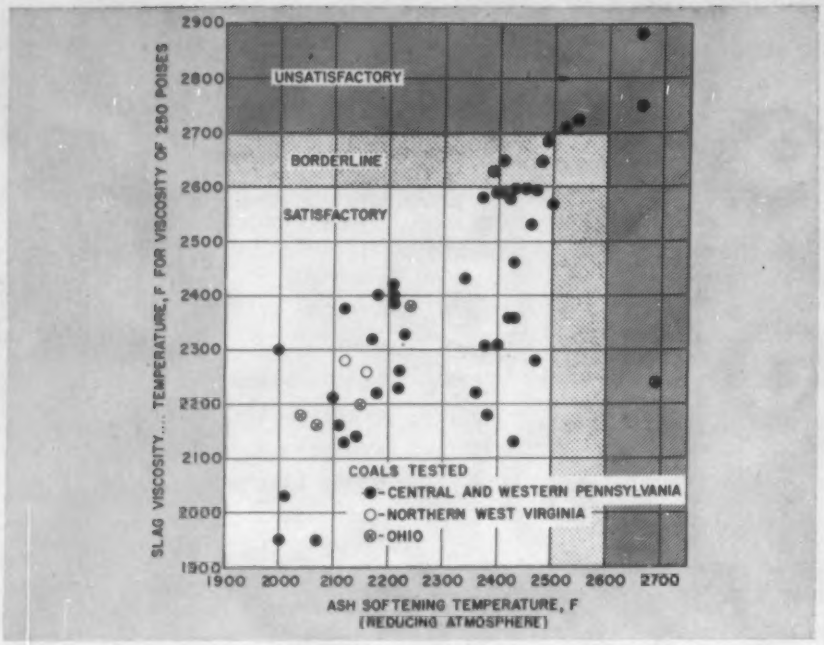


Fig. 4. Tests on certain coals to determine their suitability for cyclone furnaces

2. The cyclone furnace operates with only 10 per cent excess air, and carbon losses are exceedingly small. Therefore, for comparable stack-gas temperatures, the boiler-unit efficiency is higher than that obtainable with pulverized-coal or stoker-fired units.

3. A single cyclone furnace can burn three to four times the amount of fuel fired by a typical pulverized-coal burner. This reduces the number of burners which must be provided and controlled, and minimizes platform and grating requirements.

4. Because of its simplicity, reliability, and capacity for high burning rates the cyclone furnace is easily adapted to remote control with a minimum of apparatus and interlocks.

5. Two general types of gas-cooling boiler furnaces have been developed for use with cyclone furnaces (cyclone burners;) in one, the boiler furnace is divided into a lower primary section and an upper secondary section by means of a water-cooled screen. In the other, the open furnace arrangement, the products of combustion from the cyclone furnace discharge into the lower zone of the boiler furnace and do not pass across any convection heat-absorbing surface until they leave the boiler furnace.

The flue-gas dust loading is approximately 10 per cent of the coal ash when using the screened boiler-furnace arrangements boasting a screen. Even with the elimination of the furnace screen the flue-gas dust loading is only 15 per cent of the coal ash — as compared to approximately 50 per cent with slag-tap pulverized-coal firing and about 85 per cent in dry-ash pulverized-coal fired units.

The ASME recommended stack dust loading is 0.85 lb per 1000 lb of gas, based on operation with 50 per cent excess air (150 per cent total air). With most coals, cyclone furnace boilers having water-cooled screens in the boiler furnace meet this requirement without the use of dust collectors, as can be seen from Fig. 3.

6. If a cyclone furnace boiler incorporates a dust collector, the problem of dust disposal can be solved easily by returning all of the dust collected to the cyclone furnace and converting it into slag. This eliminates the necessity of a dust-storage and disposal system and increases the amount of salable slag.

7. Stack dust from cyclone furnace boilers is much finer than that from pulverized-coal-fired units. The settling rate of cyclone furnace fly-ash is thus very much slower than that from pulverized-coal-fired boilers.

8. Maintenance costs on cyclone furnace units for crushers, feeders, and burners are about one-quarter those for pulverizers and burners on pulverized-coal-fired units burning the same coals. Because fly-ash from cyclones is so soft, erosion and wear on tubes, fans and motors is greatly reduced.

9. Recent analyses show that the auxiliary power requirements for cyclonic firing are less than those of pulverized coal firing when using low grindability, low-heating-value coals, and greater than those of pulverized coal firing when using high grindability, high-heating-value coals.

10. The availability record of cyclone furnaces is excellent. Operating records of several installations show that less than 1.5 per cent of possible availability has been lost due to cyclone furnace outages.

The advantages incident to cyclone-furnace firing apply to small and medium size boiler units just as they apply to large units. Most of these advantages may be measured directly in dollars and cents. However, any evaluation with other methods of firing should not overlook the intangibles favoring the cyclone furnace. These intangibles often may have a greater bearing on the decision than the matter of investment cost alone. As an example, a plant may be located close to the center of town where a fly-ash nuisance from either pulverized-coal or spreader-stoker-firing could not be tolerated. In other cases, the fly-ash collected in precipitators may pose a real disposal problem, not only in urban areas, but in outlying areas as well. With growing restrictions on effluent to rivers and lakes to prevent stream pollution, this fine, water-borne ash may be increasingly difficult to dispose of economically. In such a case the plant owner would feel justified in the installation of cyclone furnace units even though the first-cost economics were not favorable.

Another case would be that of a plant which could not tolerate stack emissions from either pulverized-coal or spreader-stoker-fired boiler units because of a possibility of product contamination. Cases in point might be a textile plant, a nylon plant, a metal-finishing plant where the finished product must have a flawless or highly polished finish, or even a paper mill producing a very high-grade bond. In such cases, the plant owner might feel justified in making an additional investment to install the cyclone furnace as insurance against product contamination.

The general simplicity of operation, increased safety, and ease of switching from fuel to fuel are other intangible benefits which, while difficult to evaluate in direct terms, are often of exceedingly great importance in the over-all economics of profitable operation.

Conclusion

We conclude that from a design and manufacturing point of view it is entirely practical to build cyclone furnace boiler units in sizes as small as 60,000 lb of steam per hr with the present level of knowledge and experience. Further, that these small units are capable of paralleling operation of and producing benefits proportional to, the larger units. Experience to date has indicated that the cyclone furnace unit is competitive with pulverized-fuel and spreader-stoker units in sizes above 150,000 lb of steam per hr. Below 100,000 lb per hr, the economics generally favor other methods of firing such as spreader and chain-grate stokers. However, there are many important intangible benefits which often may make the cyclone furnace of interest on smaller units.

The material in this article is condensed from a paper presented at the 17th annual ASME-AIME Fuels Conference, Pittsburgh, Pa, in October 1954.

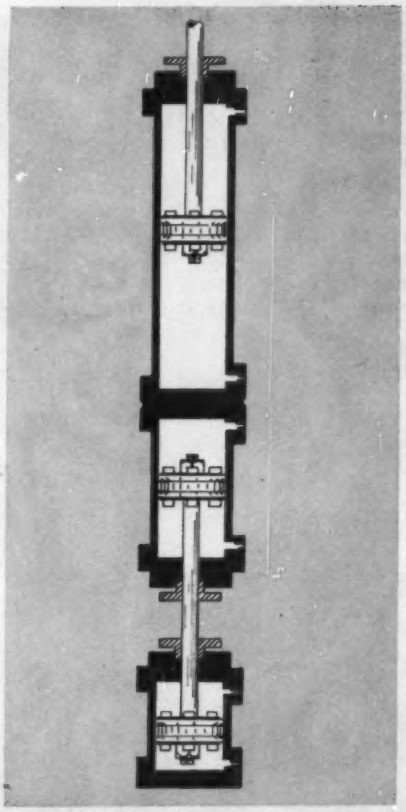
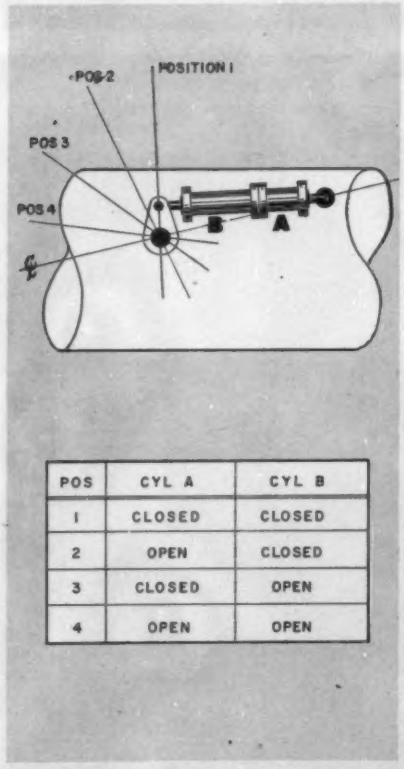


Fig. 2. Three cylinders in series, two of which are mounted on a common piston rod. Rod is supplied by manufacturer



POS	CYL A	CYL B
1	CLOSED	CLOSED
2	OPEN	CLOSED
3	CLOSED	OPEN
4	OPEN	OPEN

Fig. 3. Schematic arrangement of the two air cylinders shown in Fig. 1 as applied to a butterfly valve controller

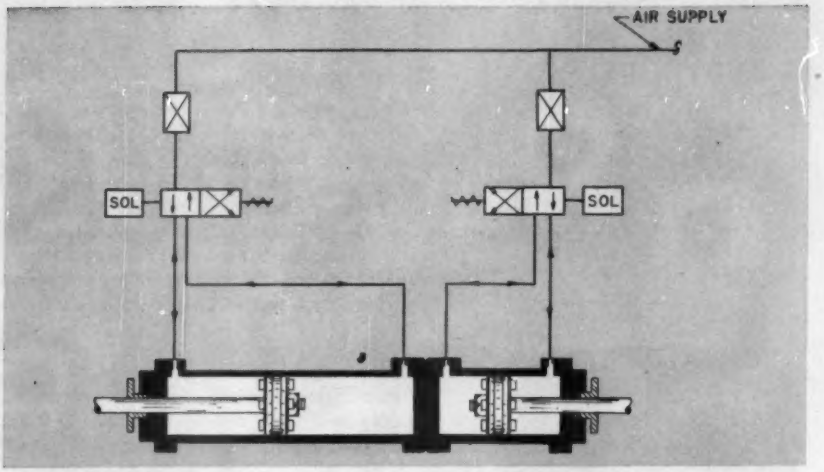


Fig. 1. Two standard air cylinders in series with separate solenoid valves to operate them separately or together

You Can Get Positive Multiposition Control with Air Cylinders

By E. F. FORHAN* and R. L. GRASS†

IN POSITIONING valves, dampers, levers and such, accurate and positive control through a range of intermediate positions often is required. A common difficulty experienced in the use of compressed air, however, is the inability of a pneumatic cylinder to hold an intermediate position against variable or reverse loading.

A problem requiring positive intermediate positioning is normally solved by using hydraulic actuation or by using automatic position controllers in conjunction with pneumatic cylinders. Hydraulic actuation is often unadvisable because of operating conditions (such as unfavorable ambient temperatures), and automatic position controllers are expensive and are limited in air capacity.

When this fundamental problem was encountered recently, it was solved without resorting to either of the usual methods. The particular problem involved positioning a damper (which was subject to load changes in intensity and direction) from fully-closed to ⅓-open, ⅔-open, and full-open. The location of the damper in an extremely hazardous area, subject to high ambient temperatures, precluded hydraulic operation. Hence, it was advisable to use the available supply of compressed air. To avoid the expense and complexity of a position controller, it was decided to use two standard pneumatic cylinders mounted back to back, with separate solenoid-operated four-way valves so that they could be actuated separately or together (see Fig. 1).

Standard air cylinders with flange mountings on the cap end were selected so that they could be easily bolted together. One cylinder has a stroke equal to ⅓ the total required stroke and the other cylinder has a stroke equal to ⅔ the total required stroke. In this way all of the positioning requirements for the damper were fulfilled by a simple, reliable system, with a resultant savings of many dollars.

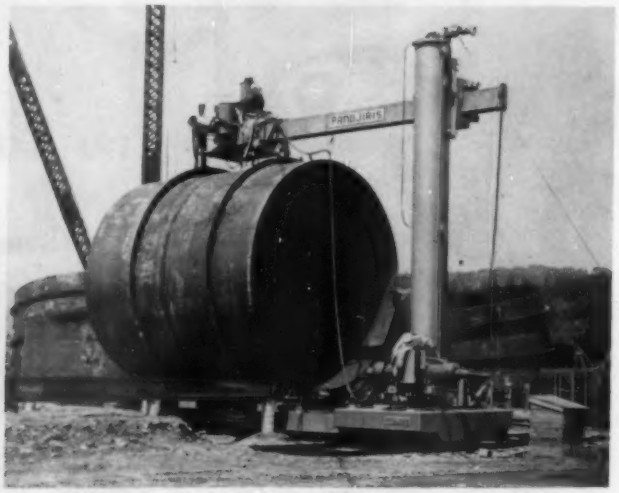
The arrangement of two air cylinders of different stroke joined in series offers two intermediate positions between full-open and full-closed. If more intermediate positions are required, three or four air cylinders of different stroke may be joined. Such an arrangement would imply the use of two air cylinders with a common piston rod (see Fig. 2), which can be supplied by cylinder manufacturers.

An arrangement of three air cylinders joined in series would provide up to six intermediate positions between full-open and full-closed. For example, if three air cylinders were selected with strokes of 3, 6, and 12 in., the intermediate positions between full-closed and full-open (21 inches) would be 3, 6, 9, 12, 15, and 18 inches. In like manner, an arrangement of four air cylinders joined in series would provide up to fourteen intermediate positions between full-open and full-closed. The feasibility of multiposition control with standdard air cylinders joined in series would depend, of course, on the nature of the particular application. Figure 3 shows a typical arrangement of a cylinder such as the unit in Fig. 1.

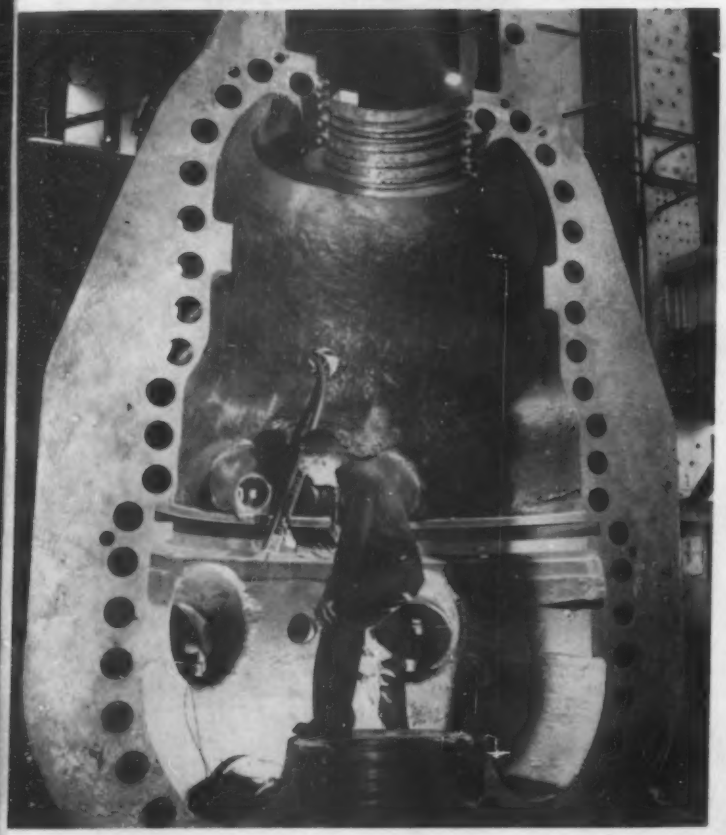
* Mechanical Engineer, and † Technical Editor, Sverdrup & Parcel, Incorporated

News Reel

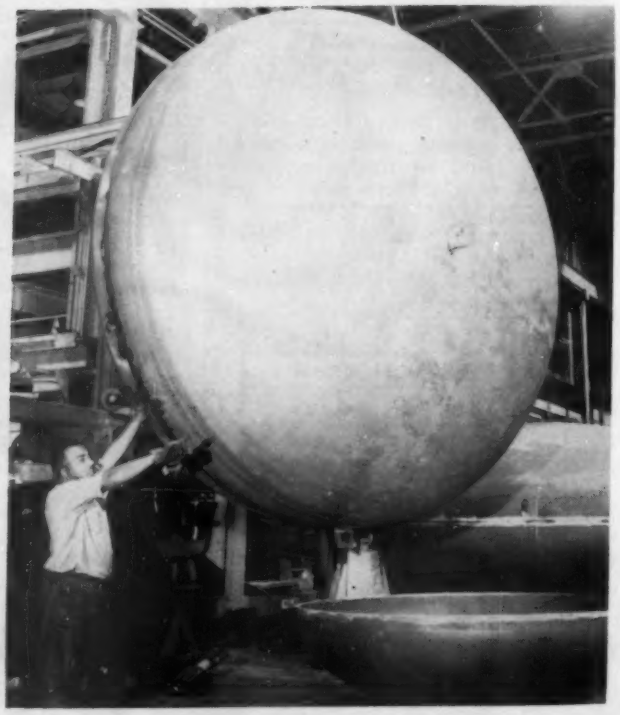
Rechargeable silver-zinc battery weighs only one-sixth ounce, is rated 1/10th amp-hr by its maker, Yardney Electric



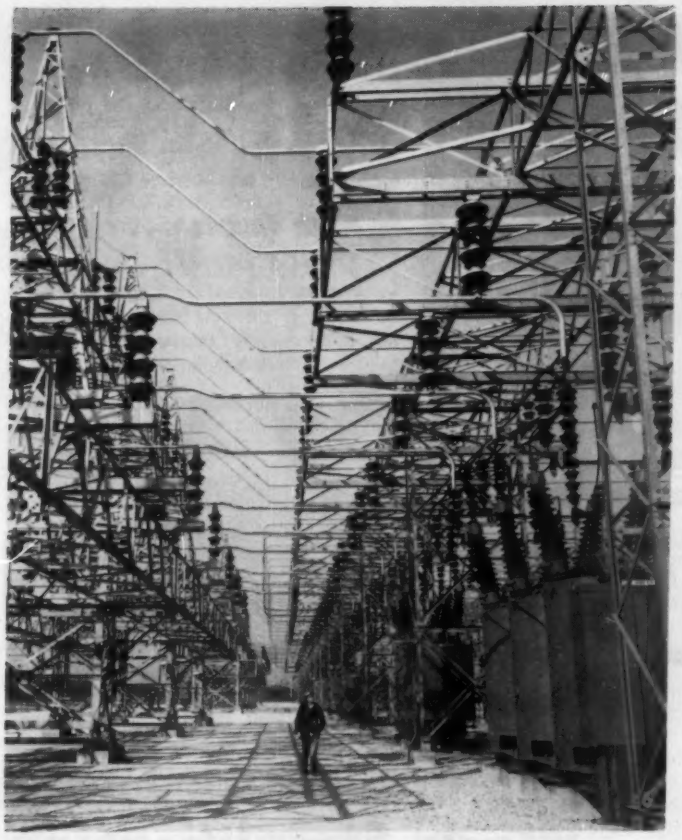
(Above) Penstocks at Littleton Dam (N. H.) are welded in an open field on site. The welding machine shown is a huge Pandjiris manipulator which is self-contained, runs 20 in./min.



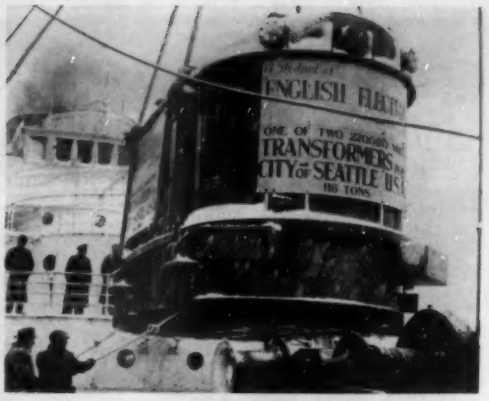
These "pear-shaped tons" are the high-pressure turbine shell of Cleveland Electric's new tandem-compound, 208-mw machine. It will have industry's first large liquid-cooled conductors



(Right) Though it looks like an oriental dinner bell, this is one of the 4000-gal oil tanks required in new high-capacity oil circuit breakers being made at G-E's Philadelphia factory

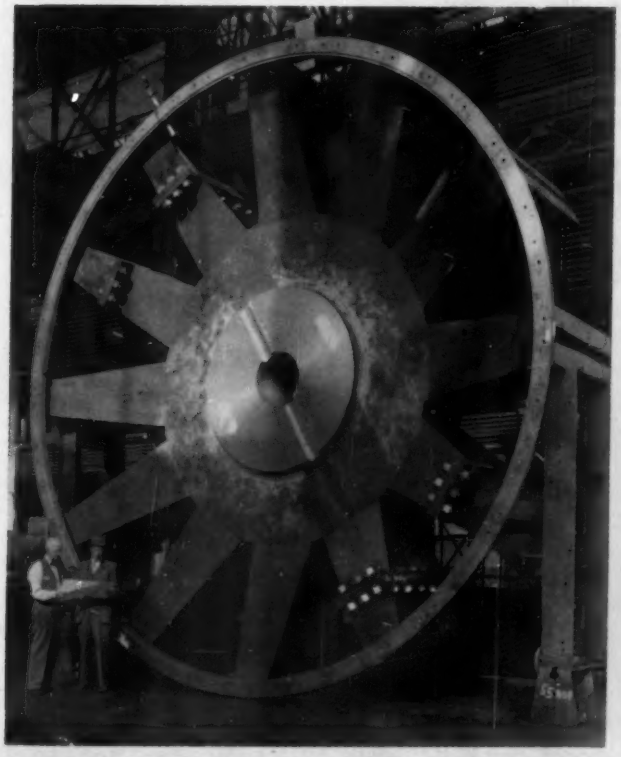


Commonwealth Edison's new Will County Station feeds the Public Service Division 160,000 kw through this 138-kv switching terminal

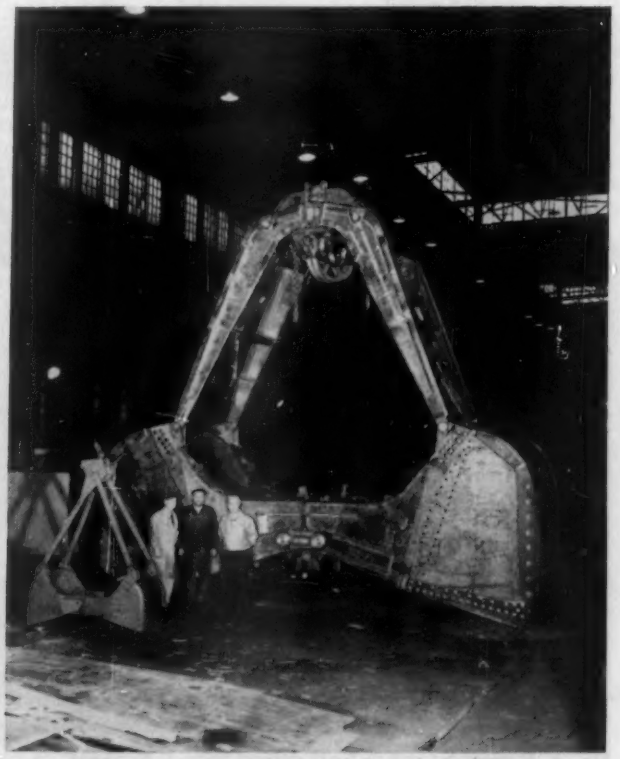


Signs of our times: One of two English Electric 220,000-volt transformers made for the City of Seattle is loaded aboard freighter at Liverpool

A new employee out of IBM by Westinghouse, this computer will double in research and design



Record-sized m-g unit for Hiwassee Dam pumped storage project (102,000 hp) will be built on this welded spider



Blaw-Knox Company recently shipped this 680-cu-ft clam-shell weighing 32,000 lb, capable of lifting another 34,000 lb

work simplification
IN ENGINEERING
VOL. 1 NO. 4 OCTOBER, NOVEMBER, DECEMBER 1954 THE DETROIT EDISON COMPANY
W S CONFERENCES RESUMED IN PLANNING / PROJECT

Fig. 1. — Left. Portion of page 1 of Work Simplification in Engineering bulletin issued by The Detroit Edison Co. to inform engineers about the program

Fig. 2. Burroughs Corp. uses Willoughby Smart as Work Simplification symbol

Fig. 3. Here's Flannel Board technique

How Power Engineers Learn Work Simplification

By breaking down work into specific jobs, making a detailed flow sheet of each, applying principles of modern human engineering and, above all, using organized common sense, power engineers can make outstanding improvements in all power production work

By LILLIAN STEMP *

TEACHING of Work Simplification principles to power engineers has resulted in improvements that make their individual work easier, as well as the work of power production itself. Numerous examples are available, from public utilities such as Cleveland Electric Illuminating, Consolidated Edison of New York, Detroit Edison Co., as well as from power plants in steel mills and other industries, to support the value of teaching work simplification to power engineers. Highly effective way in which Cleveland Electric power production men have used these methods were detailed in the March issue, page 56.

Foremost leader in teaching work simplification is Allan H. Mogensen, who has been conducting Work Simplification Conferences at Lake Placid, New York, for 28 years. Men who attend them return to their companies as instructors, and conduct classes at their respective organizations. In this way an entire plant may obtain work simplification training.

Fig. 4. Flannel board in background with J. F. Simes, at blackboard, and R. H. Arnold, extreme left lighting a smoke, staff members, conducting Work Simplification training for power engineering personnel at Consolidated Edison Co., of N. Y.

An example of the extensive approach made to work simplification techniques is that by the Detroit Edison Co. The company issues a bulletin for its engineers entitled Work Simplification in Engineering, Fig. 1.

Mogensen also holds shorter winter conferences at Sea Island, Georgia. At both Lake Placid and Sea Island, he is assisted by such leading authorities in human engineering, management, and allied fields as Dr. Lillian M. Gilbreth, Whiting Williams, Professor David B. Porter of New York University, Leo B. Moore and H. F. Goodwin, MIT, Abner Robertson, Mental Hygiene Society of Virginia and others.

Each year the interest in work simplification increases. One of the reasons is explained in a report once made by Mr. Mogensen and two of

*Technical Writer; see biography, POWER ENGINEERING, March '55, page 56.

his assistants. They stated that "through work simplification, difficult problems can be reduced to simple steps. Management can directly control efficiency by training each individual employee in the organization in that part of the science that applies to his type of work, and by making him responsible for being alert for possible improvements."

Power engineers who cannot avail themselves of training under Mogensen can obtain such training in various universities such as New York University, Marquette University in Milwaukee, University of Wisconsin, Purdue University, and others. A number of the universities will start classes if enough are interested.

Fundamental Principles

Principles of work simplification were stressed many years ago by Frank Gilbreth, when he not only talked about how human fatigue was lessened through better methods, but actually developed devices such as the Gilbreth Patent Scaffold, described by bricklayers as "making it aisy for a man to work hard."

Work simplification, as Mogensen teaches it, is approached with the same warmth and appreciation of the worker's worth as that which dominated all of Frank Gilbreth's efforts when he dedicated his life to urge industry to eliminate fatigue through the human engineering approach in motion study.

Films, gimmicks, and many other types of visual aids help to get the story of work simplification across.

Not so long ago, Tennessee Ernie, TV entertainer, was quoted in a newspaper column as saying "A man's mind is like a parachute. It functions only when it's open." Power engineers who take work simplification training learn this saying early in the course when they study how people resist the new. A typical explanation is presented in Republic Steel's work simplification training program. They teach as follows:

"We resist the new.

"Like the parachute, the mind functions only when open.

"Check your own reaction to this first challenge. When somebody presents you with a new idea, what do you do about it? Is it not true that one of the first things you say is, it cannot be done? Don't you immediately start searching for reasons why the idea won't work? What was your first reaction, for example, to knee-action, radio, electric clocks, canned beer . . . ? What would you have said, some years back, if anyone had outlined our present transport and mail plane services? Do you think that some day a few drops of water will furnish sufficient power to drive a car from coast to coast?

"Your reaction to these ideas is probably no different from the reaction of the people who laughed at Columbus, Fulton and Whitney for their impossible and unimaginable

Fig. 5. Many of the slogans taught in Work Simplification classes are being brought to the public through various channels. Here is one with an application to safely

. . . BEFORE

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY
WORK SIMPLIFICATION PROCESS CHART

JOB Transformer Replacement (After Regular Working Hours)
CHART BEGINS Supervisor on Trouble Job
CHART ENDS Transformer to Job
CHARTED BY J. H. Williamson DATE 4-3-51

DETAILS OF (PRESENT) METHOD	DIST. IN FEET	QUAN.	TIME
1 Supervisor goes to Brooklyn	7 Miles		20 Min.
2 Rings bell for guard			
3 Looks for guard			2 Min.
4 Finds guard			
5 Walks to stockroom	200 Ft.		
6 Guard unlocks door			
7 Supervisor selects trans.			2 Min.
8 " " Hookers			
9 Waits			5 Min.
10 Truck Driver picks up trans. with transporter			
11 Takes trans. to truck	50 Ft.		
12 Loads " on "			
13 Waits			10 Min.
14 Takes trans. to job	5 Miles		20 Min.
15			
16			

SUMMARY	PRESENT NO.	PRESENT TIME	PROPOSED NO.	PROPOSED TIME	DIFFERENCE NO.	DIFFERENCE TIME
○ OPERATIONS	5					
⇨ TRANSPORTATIONS	4	40 Min.				
□ INSPECTIONS	3	20 Min.				
D DELAYS	3	40 Min.				
▽ STORAGES						
DISTANCE TRAVELLED		FT.		FT.		FT.

NOTES: Guard not on job - can't hear bell. Truck driver gets transmitter. Truck driver puts transmitter away.

. . . AFTER

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY
WORK SIMPLIFICATION PROCESS CHART

JOB Transformer Replacement (After Regular Working Hours)
CHART BEGINS Supervisor on Trouble Job
CHART ENDS Transformer to Job
CHARTED BY J. H. Williamson DATE

Time Saved 1 Hr. 10 Min.

DETAILS OF (PROPOSED) METHOD	DIST. IN FEET	QUAN.	TIME
1 Supervisor calls Goodrich for trans.			
2 Driver moves truck to platform	200 Ft.		10 Min.
3 Selects trans. as per telephone call			
4 Slides trans. from platform to truck			
5 Takes trans. to job	5 Miles		20 Min.
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

SUMMARY	PRESENT NO.	PRESENT TIME	PROPOSED NO.	PROPOSED TIME	DIFFERENCE NO.	DIFFERENCE TIME
○ OPERATIONS	5		1		4	
⇨ TRANSPORTATIONS	4	40	3	30	1	10
□ INSPECTIONS	3	20	1	—	1	20
D DELAYS	3	40	0	—	3	40
▽ STORAGES	0		0		0	
DISTANCE TRAVELLED		FT.		FT.	0	FT.

NOTES: Gives trans. size. Engrs. trans. & installs. Hookers available at loading platform.

Fig. 6. Flow Chart before and after Work Simplification principles were applied

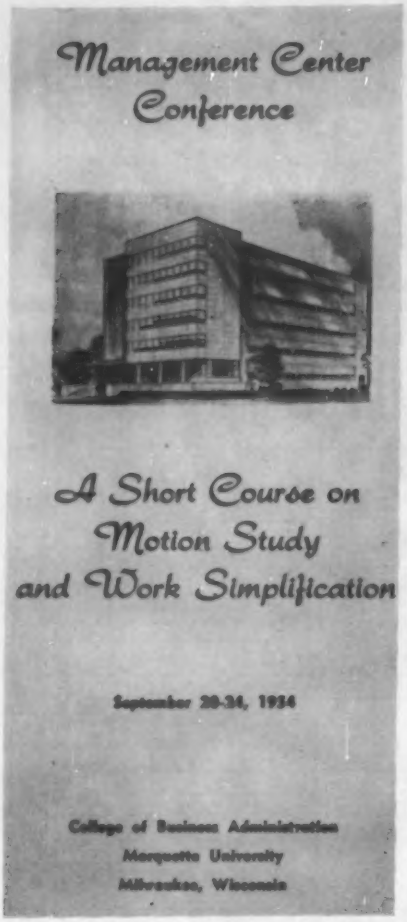


Fig. 8. Cover, typical university announcement of work simplification courses, this one by Marquette University

ideas. History is full of examples of this resistance to the new. . . .

"If we are to get along with people, consideration must be given to the human failing of resistance to the new. The moment we forget this we are wasting our time and effort and our results will be disappointing."

Work simplification as Mogensen teaches it "is the organized use of common sense, on the part of everyone involved, to find better and easier ways of doing work." As part of that "organized use" he introduces a five-step pattern which includes:

1. Pick a job to improve;
2. Make a flow process chart;
3. Question the job;
4. Develop the new method;
5. Apply the new method.

In picking a job to improve, the bottle-neck operation, the unpleasant job, are among the types the work simplification-trained power engineer would seek. The idea may originate with him or a problem may be presented to him by one of the power plant employees when it occurs. For example, at Consolidated Edison of New York, whenever the salt water header and nozzles in the revolving screen installation in front of the condensers at the Hudson Avenue station became clogged with dirt and other debris, it was necessary to shut down the screen and remove in its entirety one of the ten baskets constituting the screen, in order to gain access to the header and nozzles to clean them. The removal of an entire basket involved considerable labor.

PROGRESS TOWARD 1954 MECHANIZATION GOALS

Percent of goals (savings) attained in first eleven months of 1954

Office Elements	198%
Power Production & Engineering Group	103%
Distribution Group	93%
Electrical Operations & Engineering Group	92%
Total Company	99%

Note: The original 1954 Company Goal was increased $35,000. We have attained 113% of the original goal.

Fig. 7. Cleveland Electric Illuminating Company's mechanization savings achievement for first 11 months of 1954

Viewed with work simplification eyes, a suggestion was made to install a removable section on one of the ten baskets, bolting it in place in such a manner that it lends itself to easy removal. The adoption of the new method resulted in a much quicker, easier and safer method of reaching the header and nozzles for cleaning.

Making a flow process chart is stressed because it gives a bird's-eye view of the job. It provides a picture separating the job from its background and surroundings. You don't have to depend on memory to study the job. In fact, Cleveland Electric Illuminating Co. emphasizes this angle with this slogan: "If you don't flow it, you don't know it! Use the flow process chart!"

Mechanics of making a flow process chart, Fig. 5, are practiced, of course, with these key points emphasized.

1. Choose the subject to be followed, selecting either the man or material — whichever goes through the entire process. Each detail must refer only to that subject.
2. Write a brief description of each detail, recording the job from actual observation of the job while the job is being done.
3. Classify the steps as to one of the five elements of work — operation, transportation, delay, inspection, storage.
4. Apply the symbols and draw a line connecting them so that you have a "flow path" which gives a graphic picture of the process.
5. Enter distance and time.
6. Black in the *do* operations to help make the really productive acts stand out. The rest is makeready and put away.
7. Summarize. Enter the results in the summary block so that you can see the job at a glance.

Throughout work simplification training, the human engineering aspects are given the spotlight, and this is particularly true when it comes to putting point five in the five-step pattern into effect — "apply the new method." Consulting with everyone concerned, how to put ideas across, how to express yourself so that you can do a good job, giving proper credit where due — all these factors are taught and practiced.

Even a minor exposure to work simplification philosophy has shown benefits, but where an active program has been established with follow-up procedures, and stimulation, as has been the case with the Cleveland Electric, power engineers can make a good showing (see POWER ENGINEERING, March, 1955, page 56). Note the accompanying record published by Cleveland Electric, as shown in Fig. 6.

Some of the proposals that figured in the power engineering record include one by Plant operations engineer Willis Williams, of Cleveland's Eastlake Plant. By interconnecting vacuum pumps on three of the units by motor-operated valves, they eliminated the need for purchasing and installing a vacuum pump on the No. 4 unit.

Also at the Eastlake Plant, Civil Engineer W. L. Zesiger came through with a work simplification proposal that resulted in a substantial savings. "By using more economical sections and modifying the hopper design, the capacity of the No. 4 unit bunker was increased by 17 per cent, the weight reduced 27 per cent, and the cost per pound of steel by 6¼ per cent."

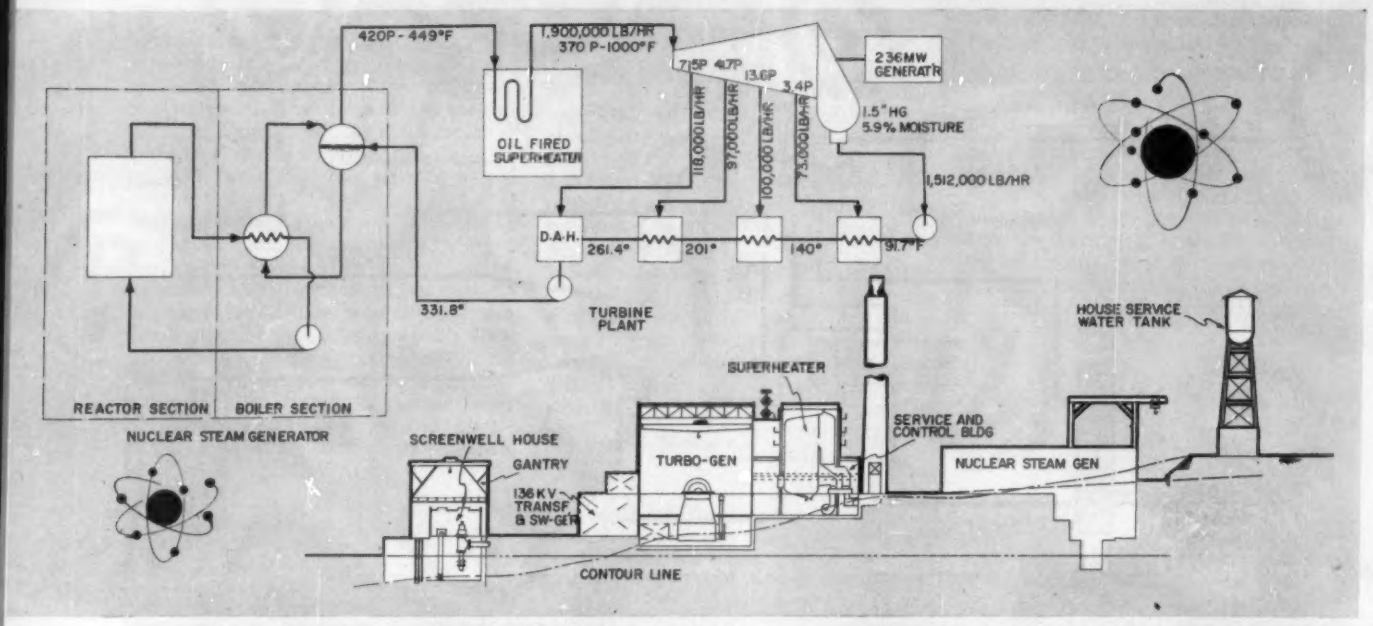
Power engineers who have had motion and time study training already appreciate the possibilities in work simplication training. For those who would like to whet their appetites, the following books have often been recommended.

References

Mogensen, A. H. Common Sense Applied to Motion and Time Study. New York: McGraw-Hill Book Co., Inc., 1940.
Gilbreth, F. B. Motion Study. New York: D. Van Nostrand Co., 1911.
Barnes, R. M. Motion and Time Study. New York: John Wiley & Sons, 1940.

Effect of Atomic Blast on Electrical Equipment

EFFECTS of an atomic explosion on electrical equipment were tested in the atomic bomb test scheduled for April 26 at the Nevada Test Site. Duplicate installations at different distances from the test explosion and outside the area of total destruction were constructed. Andy Kramer, POWER ENGINEERING's Editor, who witnessed the test, will present a detailed report of it in the June issue.



Lower right. Outline elevation for proposed nuclear plant. Unusual feature is stack for discharging combustion products from superheater. Conventional nuclear plants have no stack or smoke. Upper diagram shows plant heat balance

Consolidated Edison To Build Nuclear Power Plant

IN FEBRUARY 1955 Consolidated Edison Co. of New York, Inc., announced its intention of building a nuclear steam electric power plant, to be known as the Indian Point Station, in Buchanan, New York, on a site 24 miles north of New York City line on the east bank of the Hudson River. This was the first announcement by a utility company of its readiness to proceed, without Government aid, since the passage by Congress of the Atomic Energy Act of 1954 opened up the possibility of the development of nuclear steam generating stations by private capital.

The proposed nuclear steam generator is an assembly of a nuclear reactor, a recirculating high pressure coolant system to remove the heat generated in the reactor and to transfer it to boilers, which in turn remove the heat from the coolant by generating steam. The reactor is of the type known as a pressurized water uranium thorium convertor. The reactor consists of a large steel cylindrical vertical tank which is partially filled with shielding water and contains a small vessel in which is the core. The core of the reactor consists of a geometrical pattern of closely spaced fuel elements which contain the nuclear fuel. The basic fuel is enriched uranium, that is, uranium containing a higher amount of uranium 235 than natural uranium as mined from the earth. Uranium 233, which also serves as a fuel, is obtained by the conversion of thorium 232 into uranium 233 within the reactor itself. The fuel elements will be protected by a corrosion resistant material designed to prevent the coolant water, which passes over the element surfaces, from becoming contaminated with radioactive fission products (the ash from nuclear fuel). Control rods, which start and stop the reactor and regulate the amount of heat produced by the reactor, are interspaced within the fuel elements and are positioned by remote hydraulic or electrical means. The coolant system consists of four pipe loops operating off the reactor core and serves both to absorb the heat generated in the core and to deliver heat to the boilers. Each loop consists generally of pumps, a boiler, shut-off valves and interconnecting pipe. The pumps continually circulate the coolant water at a pressure of about 1500 psi. The coolant flow is equally divided in these loops and the steam generated by each boiler is fed to a steam header.

Each boiler consists of two major components, the boiling section and a separate steam drum. The boiling section consists of "U" shaped stainless steel tubes, the ends of which are welded into heavy tube sheets, enclosed in a steel shell. The coolant flows through the inside of the tubes. The steam generated from the water surrounding the "U" tubes will rise to the steam drums through pipes, where it will be dried by passing through a conventional steam separator. The non-radioactive steam will leave the drum at 420 psia saturated.

Each of the four boilers, with their loop pumps, coolant pressure controls, etc., will be housed in a large horizontal steel container, each of which will be vented to the vertical vessel housing the reactor core. The entire steam generator and its auxiliaries will also be enclosed within a thick dense concrete shield.

To provide for greater economy, and in order to produce higher temperature steam which will permit the use of a standard type steam turbine, the saturated steam from the nuclear steam generator will be passed through a separate oil-fired superheater, and will supply steam to the turbine throttle at about 370 psia and 1000 F capable of generating 236 mw of electrical output. The 96 mw increase in capacity over the 140 mw produced by the saturated steam cycle is obtained at a very favorable incremental heat rate and cost. The heat rate of the combined reactor and superheater is expected to be about 10,700 Btu per net kwh. The plant will cost around $230 per kw and during the initial operating period, the over-all cost of power, including taxes, depreciation, interest, fuel, fuel processing, labor and maintenance, will be about 9 mills per kwh. Later, it is anticipated, this cost can be reduced.

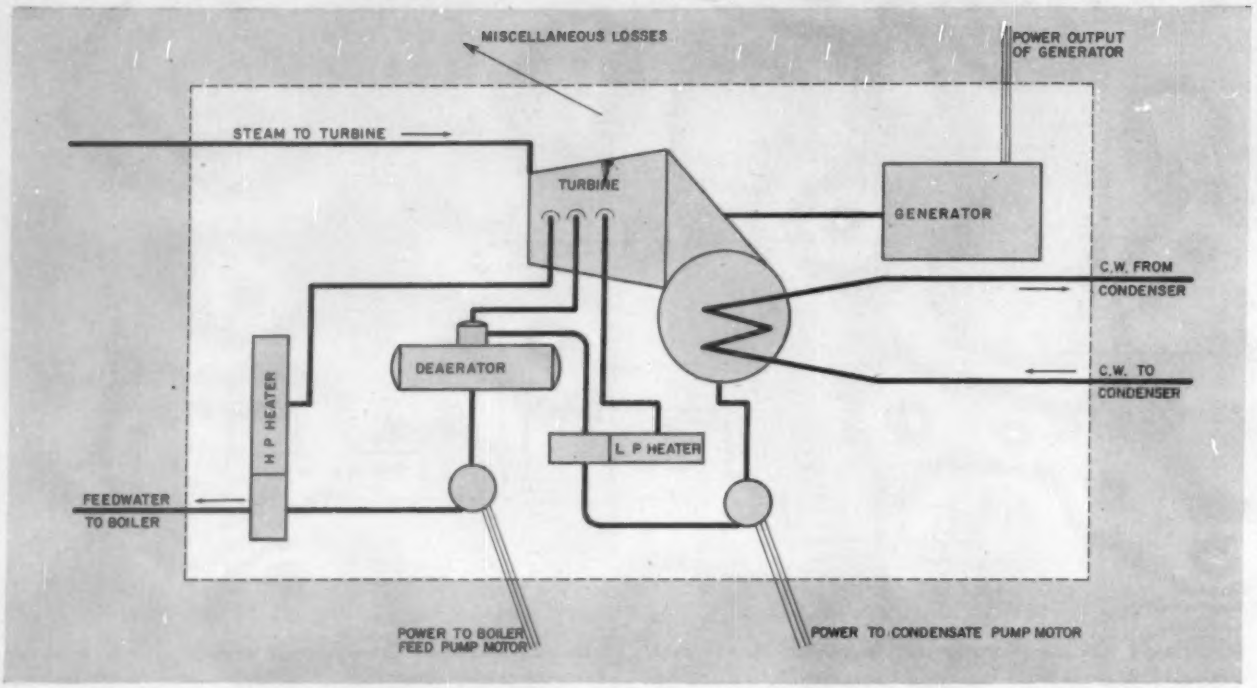


Fig. 1. Typical condensing steam power plant cycle used in determining circulating water flow by means of a heat balance

Could Your Main Condensers Pass This Aptitude Test Today?

When condensers are laying down on the job, your entire cycle efficiency suffers. When water velocities through the tubes are too high for the local water conditions, the maintenance crew suffers. Here is a lot of know-how to help you raise efficiency, cut repairs

By J. WYLLY KECK, JR.*

MAIN CONDENSERS in a steam power plant generally give operators less trouble than any other major item of equipment. For this reason the condensers are often neglected with the result that they do not operate at maximum vacuum. The effect of low vacuum is the rejecting of more heat to circulating water than is necessary. Actually, even with optimum conditions the conventional power plant turbine utilizes only about one third of the available heat in the steam while the remaining heat is rejected to water by the condenser. Over-all plant heat rate is, therefore, sensitive to variations in condenser vacuum and substantial fuel savings can be made by maintaining highest vacuum under all operating conditions.

Each condenser design has its own performance characteristics. However, most U. S. manufacturers follow the Heat Exchange Institute "Standards for Steam Surface Condensers" in making performance guarantees. These Standards among other things

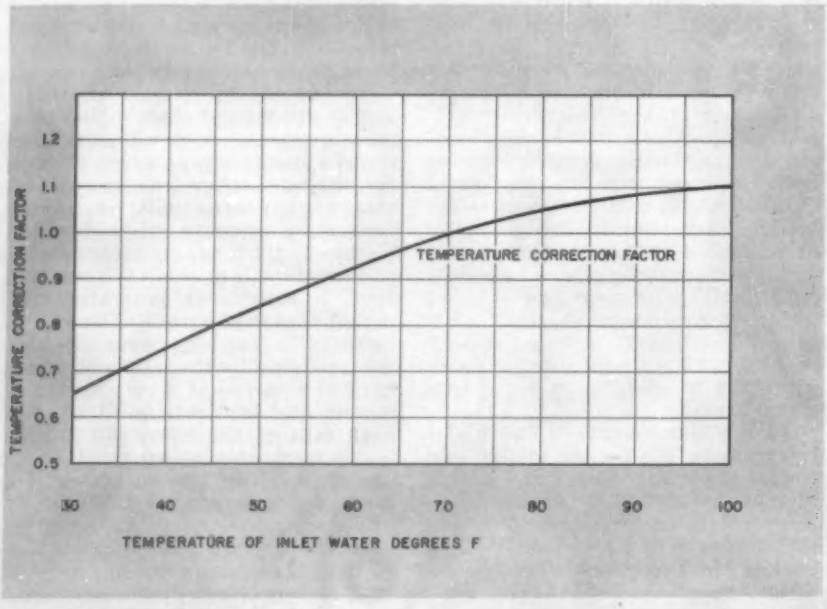


Fig. 2. Curve for determining the temperature correction factor, a multiplier of the transfer coefficient obtained in Fig. 3, showing influence of inlet temperature

*Consulting Engineer, Atlanta, Ga.

set forth commercially attainable heat transfer rates which may be expected in efficiently designed and operated condensers. Use of these Standards is the best way to determine how well a condenser is operating if the manufacturer's original performance data are not available.

The simplest approach in checking on a condenser is to compare absolute condenser pressure observed during constant load test with calculated or guaranteed pressure at same steam loading and circulating water inlet temperature and flow existing during test. For example, assume a test was run on a two-pass (water side) condenser of unknown size and manufacture operating in the cycle shown by Fig. 1. The following data were recorded:

Turbine load (kw)	11,000 kw
Steam flow to turbine (W_s)	112,000 lb/hr
Temperature steam to turbine (t_s)	800 F
Pressure steam to turbine (p_s)	605 psig
Feedwater temperature leaving H.P. heater (t_d)	300 F
Condenser vacuum	27.30 in. Hg.
Barometric pressure	29.80 in. Hg.
Temperature cw to condenser (t_1)	60.0 F
Temperature cw from condenser (t_2)	72.5 F

By actual tube count and measurement, it was determined that the condenser consists of 3118 7/8-in. OD x #18 BWG tubes, 14 ft long between tube sheets. Reference to a good handbook discloses that the above tube size contains 0.2291 sq ft of external surface per lineal foot of tube. Therefore, total effective condenser surface (S) is:

$$(0.2291)(14)(3,118) = 10,000 \text{ sq ft}$$

To calculate vacuum which may be expected when the condenser is operating satisfactorily, circulating water flow must be known. If possible this quantity should be measured directly by pitot tube, weir, or similar primary device during the test. Unfortunately, facilities for direct measurement of this flow are seldom available and it becomes necessary to establish flow by heat balance. Several heat balance methods may be used, but experience has shown best results are obtained by considering the over-all steam cycle within the dotted lines of Fig. 1. Then:

Net heat to system + pump work = work out + heat to cw + losses

If losses are arbitrarily assumed equal to pump work, these two terms may be cancelled with negligible error, giving:

$$W_s(h_s - h_d) = kw(3413) + 500(t_2 - t_1)G$$

where 3413 and 500 are conversion factors and G is circulating water flow in gpm. From steam tables h_s (enthalpy of steam at 605 psig and 800 F) is 1406.8 Btu/lb. Similarly, enthalpy of feedwater leaving cycle (h_d) is found to be 269.6 Btu/lb. Substituting these values along with observed test data in the above equation gives:

$$(112,000)(1406.8 - 269.6) = (11,000)(3413) + 500(72.5 - 60.0)G$$

Solving the equation for G yields a value of 14,350 gpm for the circulating flow. Admittedly, more accurate results are possible by direct measurement of circulating flow. However, good agreement has been consistently observed between this flow by heat balance and direct measurement in many actual field tests.

Steps necessary in the calculation of expected condenser performance may now be undertaken. First, it is necessary to determine the velocity through the condenser tubes. This is done by using the following formula with "K" values obtained from Table I.

$$\text{Velocity} = \frac{K_x \; G_x \; L}{S} = \frac{(0.310)(14,350)(14)}{10,000}$$

$$= 6.23 \text{ ft/sec}$$

Where: K is a conversion factor
G is cw flow in gpm
L is tube length between tube sheets in feet
S is total effective condenser surface in square feet

Next step in calculating condenser vacuum is determination of expected over-all heat transfer rate, U_e. Fig. 2 and Fig. 3 represent data given in the H.E.I. Standards. Entering the Fig. 3 set of curves at 6.23 fps, a U value of 658 is read for new clean tubes. Fig. 2 (temperature correction curve) gives a multiplier of 0.925 for 60.0 F inlet cw. Tube material and wall gage multipliers are given in Table II. Condenser tubes cannot be expected to remain clean and shiny after several years of service and it is, therefore, general practice in the industry to assume a tube cleanliness factor of 0.85 as being realistic for good commercial operation. This results in an expected over-all heat transfer rate for admiralty metal tubes equal to:

$$(658)(0.925)(0.85)(1.0) = 517 \text{ Btu/sq ft/F/hr}$$

As a final step in calculating condenser performance, solve the following equation for saturation temperature (t_s) of the condensing steam. Since there is a definite pressure associated with a particular saturation temperature, condenser pressure (or vacuum) may be obtained from steam tables such as included in the H.E.I. standards after calculation of t_s.

$$t_s = \frac{t_2 - t_1}{\text{anti-log}_e \left[\frac{S \times U_e}{500 \; G}\right] - 1} + t_2$$

$$= \frac{72.5 - 60.0}{\text{anti-log}_e \left[\frac{10,000 \times 517}{500 \times 14,350}\right] - 1} + 72.5$$

$$= 84.3 \text{ F}$$

A saturation temperature of 84.3 F corresponds to an absolute pressure of 1.19 in. Hg. Observed absolute pressure during test was 29.80 − 27.30 or 2.50 in. Hg. This means condenser vacuum during test was 2.50 − 1.19 or 1.31 in. Hg. lower than the value considered good commercial operation for the equipment involved. This poor condenser performance unquestionably results in unnecessarily high fuel cost per kw generated.

Probably the most common cause of low vacuum is air leakage. Every air ejector serving a power plant condenser should be equipped with an air meter. Air leakage can be maintained in any condenser at less than 5 cfm and many operators consider 2 cfm to be the maximum tolerable. Of course, if a steam jet air ejector is being used which is not equipped with an after condenser, air leakage cannot be measured until

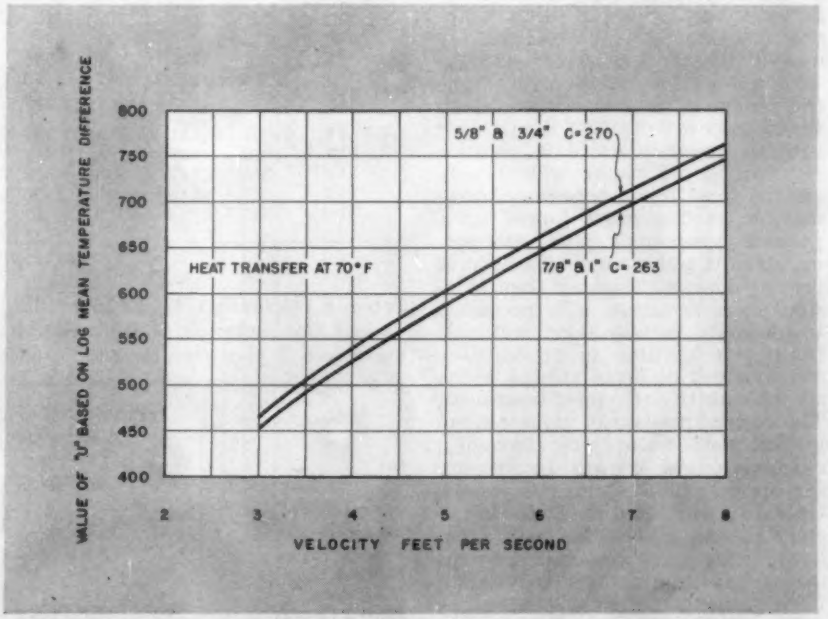


Fig. 3. Curve for determining heat transfer coefficient (U) based on log mean temperature difference. This curve and that in Fig. 2 are from Heat Exchange Inst.

Condenser Aptitude Test *(continued)*

the steam in the steam-air mixture exhausted from the jet has been condensed. Mechanical vacuum pumps, also, require a small cooler ahead of the air meter to condense vapor drawn from the main condenser. Any air leaks in the condenser shell can be located by filling the unit with water. Leaks from lines connecting to the condenser may be located during operation by shutting off one line at a time and noting whether or not there is a decrease in air leakage. Remember, leakage throughout the entire sub-atmospheric heater system contributes to leakage measured at the air meter.

An alternate rule-of-thumb check for excessive air leakage that does not require an air meter is performed by slowly closing the suction valve to the air ejector. If air leakage is normal, vacuum should not drop more than one inch of mercury during the first ten minutes after the valve is completely closed.

Another frequent cause of low vacuum is dirty tubes, which excessively impair heat transfer from condensing steam to circulating water. Most operators are familiar with the "plug shooting" technique which is used to clean internal tube surfaces mechanically. This consists of forcing rubber plugs, wire brushes, and other similar devices rapidly through the tubes under air or water pressure. Some local conditions occasionally make it desirable to clean internal surface of tubes chemically. Effective chemical cleaning requires a knowledge of the scale and necessitates reasonable control over the reaction.

In many localities various forms of algae (slime) contribute heavily to water side fouling of tubes. Chlorine or compounds of chlorine are most frequently used to combat algae with application being made while the condenser is in operation. Relatively large intermittent dosages are generally most effective. A chlorine residual of 0.5 ppm will usually destroy most micro-organisms; however, in certain cases copper salts, phenolic compounds, potassium permanganate, and other chemicals have proved more satisfactory than chlorine. In some areas, it is necessary to alternate various toxic materials from time to time to prevent the development of algae strains which are immune to one type of treatment. The correct method of algae control is best determined after biological examination of growth to identify the specific type of algae involved. Operators are cautioned to insure good mixing of chlorine and circulating water and to avoid extreme dosages as tube damage may result from concentrated solutions.

The steam side of condenser tubes often become coated with scale due to carryover from the boilers and from lubricating oil in the case of steam engines. Chemical cleaning is the only answer to steam side deposits. As in the case of water side deposits, a knowledge of the deposit is necessary for effective chemical cleaning. In older low-pressure turbine-condenser units, steam side encrustations of as much as $\frac{1}{8}$ in. in thickness have been encountered on condenser tubes. Needless to say, vacuum carried by such units is extremely poor.

Where leaves and other relatively fragile entrainments tend to blanket the tube sheets, hydraulic washers located in the waterboxes have proved effective in shredding the foreign material and forcing it to pass on through the tubes while the unit is in operation. These washers consist of a high pressure water nozzle mounted in a ball joint allowing a turbulent stream to be directed over the entire face of the tube sheet.

Table I. Conversion (K) factors in formula for water velocity inside tubes

Tube OD	Gage BWG	Wall Thickness	Value of "K" — Number of water passes: Single	Two	Three
⅝	18	0.049	0.240	0.481	0.721
	17	.058	.258	.515	.773
	16	.065	.272	.545	.817
	15	.072	.289	.577	.866
	14	.083	.317	.634	.951
¾	18	0.049	0.188	0.377	0.565
	17	.058	.199	.399	.598
	16	.065	.208	.417	.625
	15	.072	.218	.436	.654
	14	.083	.235	.470	.705
⅞	18	0.049	0.155	0.310	0.465
	17	.058	.162	.325	.487
	16	.065	.168	.337	.505
	15	.072	.175	.350	.525
	14	.083	.186	.372	.558
1	18	0.049	0.131	0.263	0.394
	17	.058	.137	.274	.411
	16	.065	.141	.283	.424
	15	.072	.146	.292	.438
	14	.083	.154	.308	.461

Table II. Multipliers to be used for various tube materials and gages with the Figure 3 heat transfer coefficients

Tube Material	Tube wall gage: 18 BWG	17 BWG	16 BWG
Admiralty metal	1.0	0.98	0.96
Arsenical copper	1.0	.98	.96
Aluminum brass	.96	.94	.91
Muntz metal	.96	.94	.91
Aluminum bronze	.90	.87	.84
90–10 Copper nickel	.90	0.87	0.84
70–30 Copper nickel	.83	.80	.76

Before 1930, condenser designers often packed tubes so closely together in the condenser that steam could not readily penetrate the tube bundle. Generally, a well designed modern condenser has about $\frac{1}{4}$ to $\frac{1}{3}$ of its tube sheet occupied by tubes. If an older condenser has more than this percentage occupied, chances are very good that higher vacuum can be obtained by removal of certain tubes. Removal of excess tubes or relaning is properly done by opening paths to allow the entrance of steam into the tube bank. Care should be taken to avoid bypassing steam directly to the air ejector offtake or even directly to the closely packed air cooler section. Often it is possible when relaning to construct a reheating and deaerating assembly above the hotwell if one was not originally provided.

After removal of tubes for relaning, the velocity of water in the remaining tubes will probably be greater. This results in a possible secondary advantage by increasing over-all heat transfer rate of the remaining tubes. When relaning, new water velocity in the tubes should be calculated from the circulating system head curve and pump curve. Keep velocity of clear fresh water under 8 fps and clear salt water less than 7 fps. If water contains silt, wastes, or other contaminants, correspondingly lower velocities must be used to obtain a reasonable tube life. Should it be necessary to reduce flow, remember that throttling of the circulating pump requires more power than reduction of its impeller diameter.

A majority of condensers are arranged for siphon operation of the cw circuit. In this arrangement, circulating pumps overcome system frictional resistance only since there is no net change in water elevation. It is quite likely that in this type system, points of highest elevation will be subjected to sub-atmospheric pressures. Any leak in this part of the system allows air to enter the circulating water line. The most obvious result is the displacement of water by air in the uppermost condenser tubes. A less apparent result of air leakage into the system is the destruction of the siphon effect. This imposes a higher head on circulating pumps than the designer intended, thus reducing water flow to the condenser. Good operators often install a gage glass on the highest part of the waterboxes. When air accumulates in the waterbox, a small air ejector or priming jet is operated to remove the air which has leaked into the system.

Finding circulating water system leaks can be very difficult. If a valve is located in the discharge line or "overboard," the valve may be throttled until the whole system is under positive pressure allowing visual location of *continued on page 114*

Stainless Steel Coal Ducts Stop Trouble in Maintenance and Operation

By J. L. RAYMOND *

COAL DUCTS from bunkers to pulverizers at Forstmann Woolen Co. were a maintenance expense and a source of operating difficulties for many years until they were replaced by ducts of stainless steel construction. Use of stainless steel has completely eliminated these troubles.

In the two power plants of this company, there are a total of eight ducts that deliver coal from the overhead bunkers to the automatic scales, and from the scales to the pulverizer feeders. The illustration shows a typical duct arrangement. For each pulverizer, there are three 18-in. diameter bunker outlets, joined by a flat-sided junction box, which discharges into the coal scale. Underneath the coal scale, there is a flat-sided hopper section with a sloping bottom, which delivers to the pulverizer feeder through a 22 ft-long vertical round pipe. This pipe is 18 in. in diameter at the top, and flares out to 20 in. in diameter at the bottom.

Former Coal Stoppages

Coal burned is bituminous slack. When this coal was wet, or contained excessive fines or ash, there were frequent stoppages of flow to the pulverizers due to coal sticking in the pipes. At times, these conditions became so bad that extra manpower had to be called in to help with the poking and the rapping of the ducts. The rapping took some life out of the ducts, but was necessary in order to keep the plants in operation. As the ducts became older, holes developed, which caused leakage of coal. These holes required temporary patches to keep the pulverizers in service until permanent patches could be installed.

Original ducts were constructed in 1932 of ¼-in. thick copper-bearing steel. By 1938, deterioration had become so extensive that whole sections had to be replaced. The first replacement ducts were of like-for-like construction, using mild steel. During the war, quality of the coal decreased and ash content increased, so that corrosion and abrasion reduced the life of the replacement ducts to only 3 or 4 years.

As soon as stainless steel became available after the war in 1946, one of the lower pipes was replaced by a pipe constructed of Type 304 stainless steel as a trial. Instead of using the same ¼-in. wall thickness as the original steel ducts, the wall thickness with stainless steel construction was reduced to ⅛ in. in order to minimize the cost. Mild steel construction was retained for the flanges. With these modifications, the installed cost with stainless steel construction was only 15 per cent greater than with full thickness mild steel.

Stainless Stops Trouble

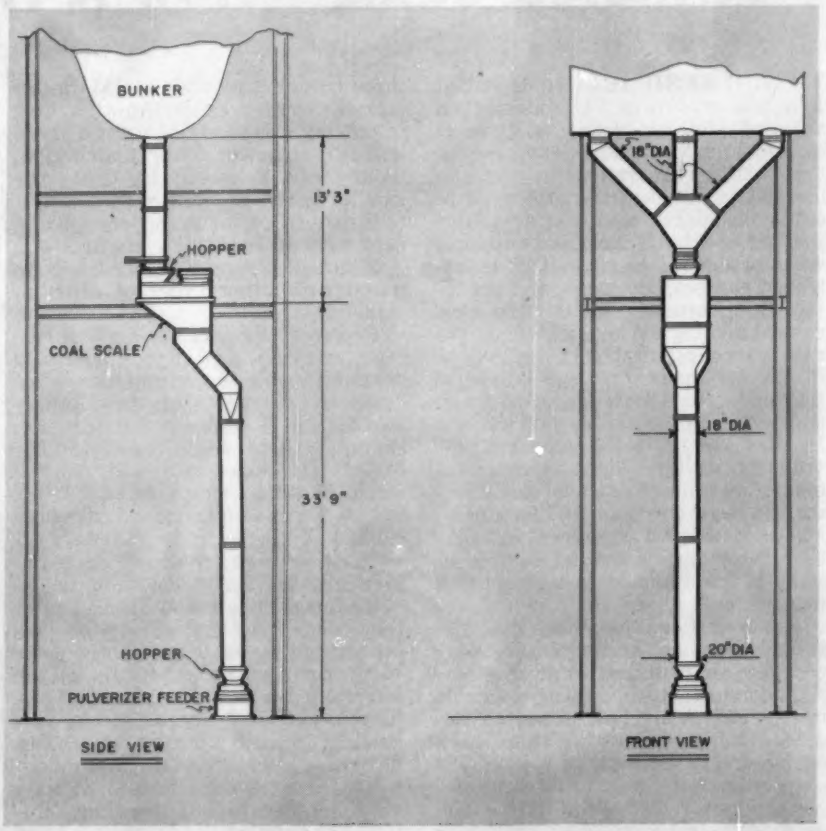
The use of stainless steel accomplished an immediate improvement in coal flow. Stoppages were completely eliminated, even under the worst conditions. The improvement in coal flow alone was considered sufficient reason to justify the additional cost of stainless steel. Accordingly, as the remaining ducts failed, they were replaced by ducts of stainless steel construction, and by 1953 all the coal ducts from bunkers to pulverizer feeders had been replaced.

With stainless steel construction, a wall thickness of ⅛ in. was used on all round ducts. On the larger flat panels, and in spots where there was impact from dropping coal, the thickness was increased to $\frac{3}{16}$ in. Experience indicates that greater stainless steel thickness is not required for corrosion or abrasion resistance, and that there is sufficient strength and rigidity without resort to stainless clad steels to get greater wall thickness.

Interior surfaces of the ducts have become highly polished from the action of the coal. Inspections to date have found no signs of corrosion or erosion. Any losses of wall thickness that may have occurred are not measurable by ordinary means. Insofar as can be determined by visual inspection, major repairs or replacements will not be required in the immediately foreseeable future.

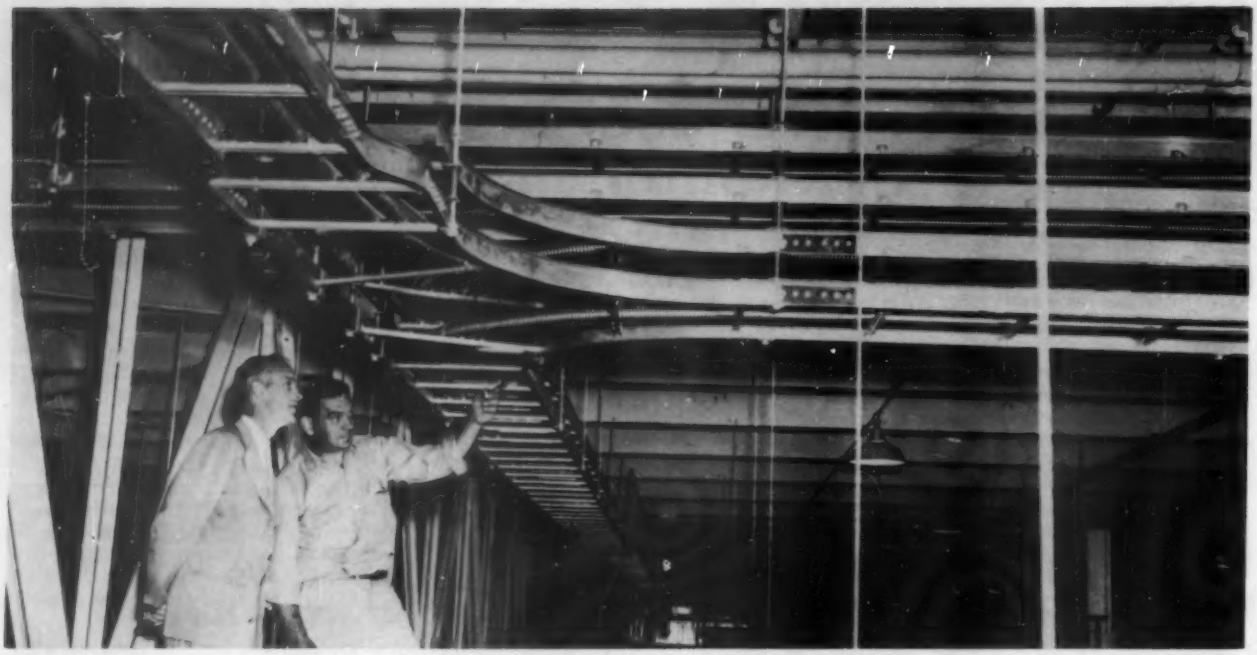
Other Applications

Further application of stainless steel to improve coal flow has been the lining of the coal scale hoppers and some of the pulverizer feeder hoppers with stainless steel. This lining used 16 gage stainless steel fitted against the insides of the existing steel hoppers, and held in place by forming around the outside edges of the hoppers. The installation of these linings has completely eliminated the choking that occurred from time to time in outlets from these hoppers.



Typical coal duct arrangement for one of 8 pulverizers at Forstmann Woolen plant

* Power Supervisor, Forstmann Woolen Co., Passaic, New Jersey.



This view shows neat streamlined appearance of system of VCI interlocked armored cables on aluminum alloy racks

In our April issue we described a new system of interlocked armored cable laid on aluminum alloy racks. Up to now it has been hard to make a neat looking job with armored cable. Now things are different. Here are some of the other advantages of this new system

Armored Cable — How It Helps Cut Costs

IN OUR APRIL issue we described a new system of VCI interlocked armored cable on racks that gives as neat looking an installation as any of the distribution systems in common use today. We described the type of cable, supports and fittings, and showed how both cable and supports were installed. The cable itself is varnished cambric insulated, and the interlocking armor permits very easy cable handling. When installed, the cables are supported on racks, troughs or baskets, made from 61S-T6 aluminum alloy. Each particular application determines the best support to use, but for all these types the supports provide high strength, light weight, nonmagnetic units that are easily installed, resist corrosion and look neat. Photo shows part of a recent installation. Now here is a brief outline of some of the other advantages of this new system.

Reduced Cost: Not only does the support system of aluminum alloy cost less than underground ducts or rigid conduit, but operating the cable in free air means that it can be run at a much higher rating than when enclosed. For example, a typical 325 amp industrial circuit uses three single conductor 500 MCM RH cables in a 3 in. conduit, compared to a three conductor 350 MCM interlocked armored cable. Another way of putting it is to say that for a given amount of power to be distributed, money can be saved by using the smaller cables possible with this system instead of the larger ones necessary with an enclosed system.

Figures 1, 2, and 3 show costs compared with other types of distribution.

Reduced Weight: For a given current carrying capacity, interlocked armored cable on aluminum alloy racks or troughs weigh considerably less than RH cables in conduit. For example, three single conductor 500 MCM RH cables in a 3-in. conduit weigh 13,235 lb compared to 5,310 lb for a 3 cond interlocked armored cable.

Space savings are shown diagrammatically in Figs. 4 and 5.

Reduced Installation Time: Unlike the older types of steel wire or steel tape armoring, which made the cable very stiff and hard to handle, the interlocked armoring makes a very flexible and easily pulled cable, thus cutting down installation time. This flexibility also saves time and money by making it unnecessary to have very detailed layout drawings. Pull boxes and splices are reduced in number, and when adding this type of cable to existing systems its flexibility enables it to be fitted into awkward locations with very little trouble.

Methods of pulling were described in our April issue. Special installation tools are available which permit several sections of cable to be pulled onto one rack at one set-up.

Reduced Outage Time: In case of a fault needing repair or replacement, interlocked armored cables on racks or in troughs are more easily accessible than enclosed cable. For the same reason, a damaged cable on an open trough or rack is much easier to locate than one enclosed in conduit or buried in underground ducts.

Appearance: As mentioned at the beginning of this article, the appearance of this new cable system, far from being untidy and less pleasing than other types of installation, gives an extremely neat-looking installation that blends well with modern equipment and building design.

The above information was included in a paper presented at the June '54 AIEE meeting at Los Angeles by L. F. Cudlin, cable specialist, General Electric Co., and F. V. Calvert, formerly vice-president, Husky Products, Inc.

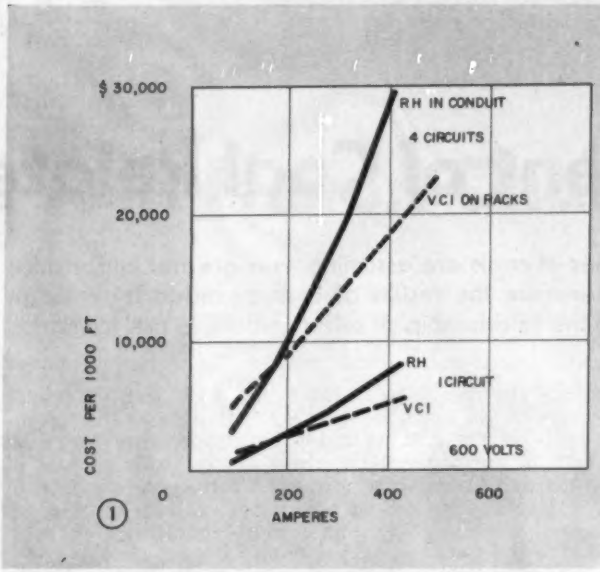


Fig. 1. Cost comparison. VCI on racks vs RH in conduit

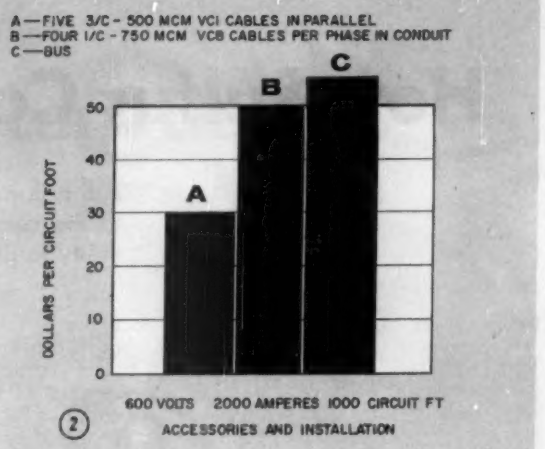


Fig. 2. Cost comparison for accessories and installation

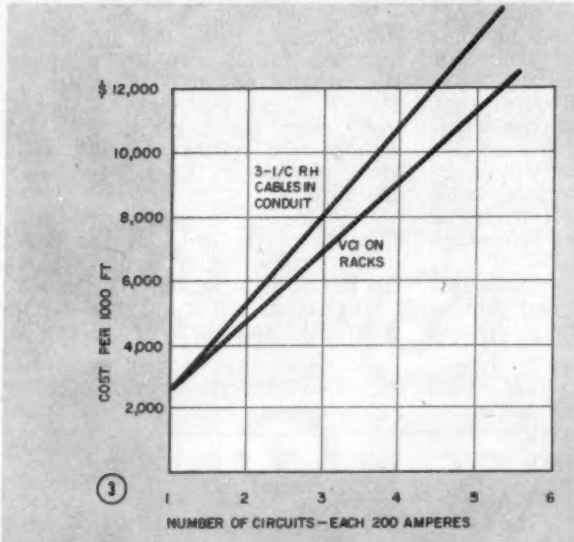


Fig. 3. Cost comparisons for a number of 200 amp circuits

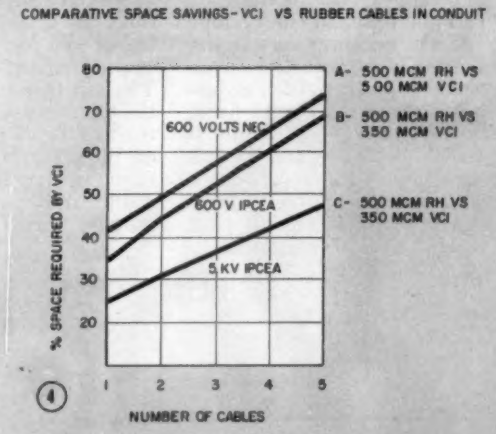


Fig. 4. Space savings for VCI vs rubber cables in conduit

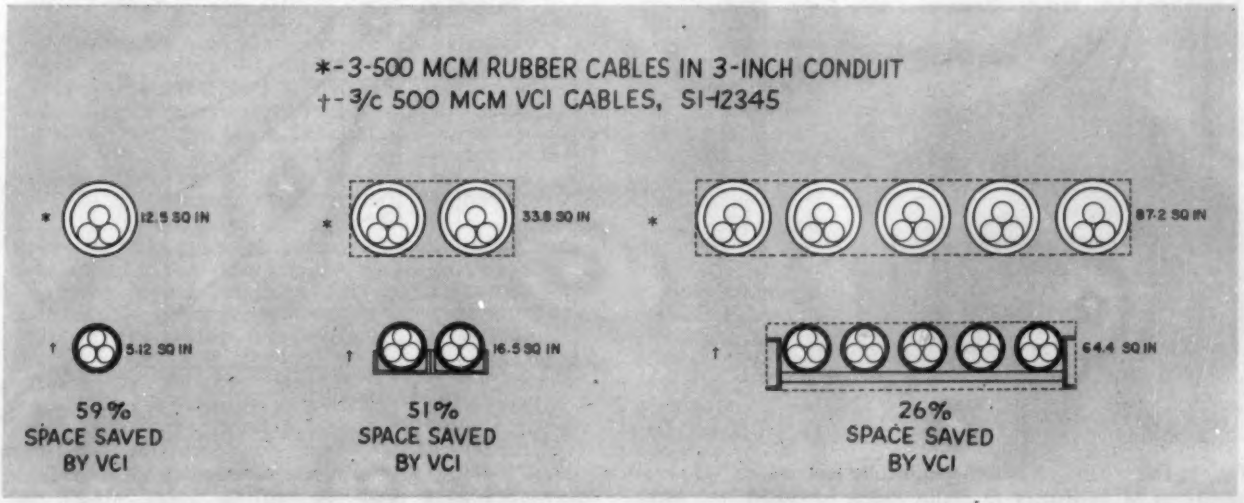


Fig. 5. Diagrams showing space saved by using 3-cond VCI armored cable instead of rubber insulated cables in conduit

How Sulfur Content of Coal Relates

Ash fusion properties of coals are assuming ever greater importance to the coal user; here are the results of a study made by a large utility to determine the relationship of sulfur content to ash formation

By FRED M. REITER

PROGRESS IN METHODS of firing coal, in its transportation, in the selection of types of coal, has given the ash fusion characteristics of coals more importance than ever before. Emphasis has shifted somewhat from the ash softening temperature values obtained in the laboratories (designated as AST or SP) to the liquid point, FP, of the lab test results. Where cyclone furnaces are under consideration, the rounded blob of the cone may become secondary to the disappearance of the cone into the ceramic base. In the cyclone furnace, the ash becomes very liquid and flows out of a tap hole like water. The conventional pulverized-coal furnace with tangential or corner firing and ample combustion volume is quite versatile with regard to ash fusion properties of coals. Then the spreader stoker, compared with traveler, chain grate, underfeed and other types of stokers, broadens the range of its coal sources, in terms of ash fusion characteristics, for stoker firing.

Each of these methods of burning coal has its own individual ash fusion requirements. Some interesting observations can be made of these ash characteristics as related to the methods of firing the coal. While the structure (density and form) of the ash produced by such divergent forms of burning as cyclone or pulverized furnaces and stokers cannot be compared, some aspects of their ash products can be examined:

Stoker firing. It is well known that there is a definite relationship between the ash fusion characteristics of the coal and the intensity of firing. The ash fusion depends greatly upon the percentage of metallic oxides in the ash, or its ratio to the percentage of refractories. The oxides of iron, calcium, magnesium, the alkalis (sodium and potassium) and similar metals, form low melting silicates with the refractory silicon dioxide of the ash. Fig. 1 illustrates the softening and liquid temperature drop with the increase in iron oxide content of the ash, with corresponding drop in SiO_2 percentage, as can be seen by examination of laboratory reports on coal ash from various seams or areas. It is almost axiomatic that coals high in metallic content show lower ash fusion temperatures.

With our underfeed multi-retort stokers using preheated air, ultra-high ash fusion coals are a must. We demand an AST in excess of 2800 F. Coals that have clinkered badly were found generally to be high in iron content, usually with some increase in CaO, MgO and alkali oxides.

One should reverse the normal thinking of the order of the three points read in a laboratory report: the initial deformation, ID, the softening point, SP, and the liquid point, FP, and think of the ash as

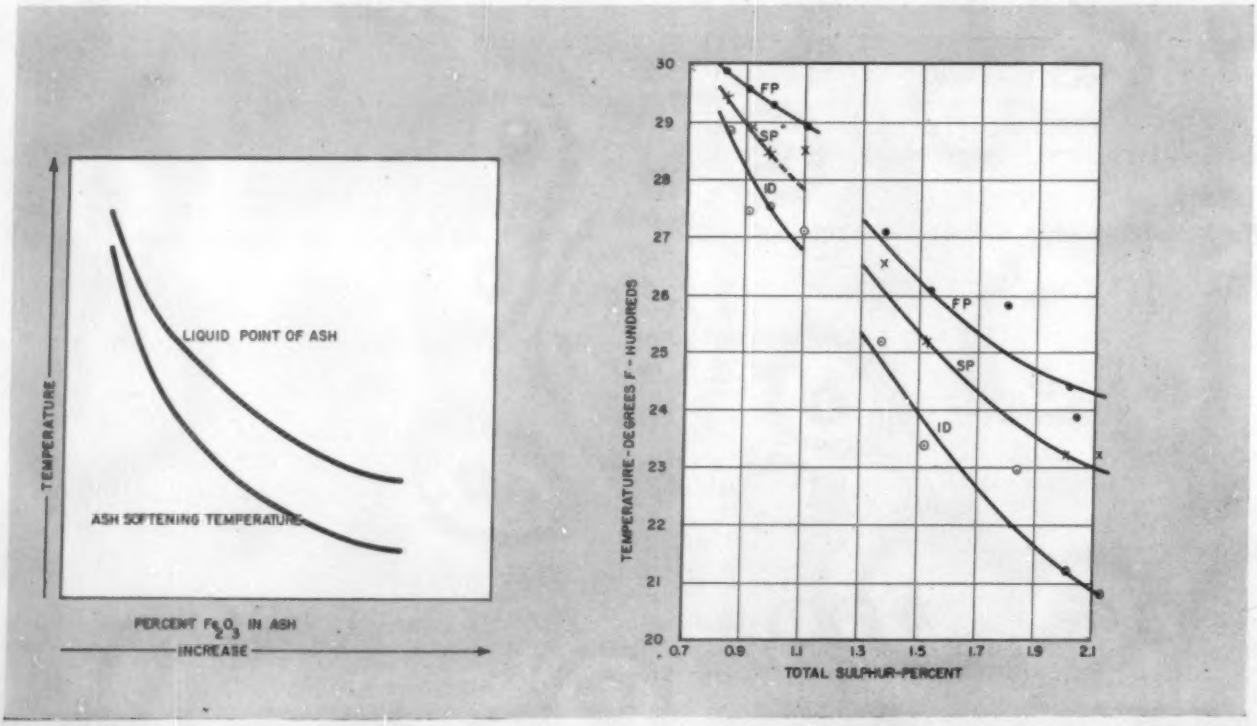


Fig. 1. This figure indicates graphically how the temperature necessary to cause fusion of coal ash drops as metallic oxide content rises

Fig. 2. Sulfur-fusion relationship of two coals tested; points plotted for initial deformation (ID), softening point (SP), liquid point (FP)

to Ash Fusion Characteristics

freezing in passing down through the fuel bed. The top ash of the bed exposed to highest temperatures will become liquid and flow back down through the fuel toward the iron oxide coated tuyeres and plates of the stoker. This liquid ash should freeze quickly. If it flows any distance and picks up compounds, or has secondary reactions that lower its freezing point, the liquid may reach the metal of the stoker and really gather up the iron oxide, remain liquid longer and fill up the air ports, and aggravate this cycle so that the stoker parts are consumed.

Ash freezing points. Look at these freezing points of the ash and the intervals between the liquid point, the softening point, and the initial deformation in the reverse order. Some average results from a number of samples of coals from various seams, showing these intervals, are listed for illustration in Table I. It is interesting to note that the high-fusion West Virginia and Kentucky coals have the small intervals. The low-fusion coals not only have longer intervals, but the freezing interval between the FP and the SP can be as long or even longer than the hardening interval between the softening "blob" and the initial deformation.

One coal that gave some trouble under heavy loads in forming heavy clinkers was analyzed for secondary reactions. A large clinker was selected from the furnace and tested for its fusion properties in the same manner as the original coal from which it came. Results are shown in Table II.

The tabulation in Table II is purely illustrative of the changes that occur in the ash fusions in secondary reaction. Regrinding the clinker in the laboratory to 60 mesh to form the test cones and reheating the new mixture, with perhaps a realignment of the particles, may have permitted new eutectics to form among the ingredients. At the high fusion furnace temperatures, additional thermal reactions carried the new readings on the clinker well below the original reactions that occurred in the boiler furnace.

Similar failures often occur in refractory brick and cements where refractories of lower temperature specification are used in applications beyond their capabilities. Fusion and shrinkage take place.

The higher the temperature relative to the fusion limits of the ash (or refractory), the harder, denser, and more glassy the clinker becomes. At one plant, we have both spreader and underfeed multi-retort stokers. They all burn the same very-high-fusion coal (Dorothy seam). The ash from the spreader stoker comes out in very small sized fluffy aggregates of rather low compression strength. The underfeed stokers produce heavy aggregate cinders that are dense, hard, and possess considerable compressive strength that make these cinders desirable for commercial use. The same coal has produced very dense glazed clinkers that verged on causing trouble in handling and possible damage to tuyeres and side plates under exceptionally severe firing conditions.

The percentage of sulfur is an approximate indicator of the ash fusion characteristics of the coal from which results might be anticipated. One might assume that 50 per cent of the sulfur in average coals may be in the iron pyrite form. This means that the percentage of iron oxide or iron in the sulphate or other form, will be higher, and therefore the ash fusion temperatures will generally be lower as the sulfur content of the coal increases. Fig. 2 illustrates general relationship between the sulfur content and the temperature of the ID, SP, and FP of certain coals as used by us. Our own boiler plant managers are watchful of the sulfur content of the coals received. The upper limits of the percentage of sulfur in our coal specifications vary with the character of the boilers at each plant. For our underfeed preheated air multi-retort stokers, demanding very high fusion coals, 0.7 per cent sulfur is the top limit; in our high heat release pulverized coal boilers, 1 per cent is the upper limit; while for our low fusion pulverized coal boiler, 2 per cent is the maximum percentage accepted.

Pulverized coal firing. A microscopic examination of the fly ash leaving the stack of pulverized coal fired boilers tells a very interesting story of the battle between the coal ash and the furnace temperature. Ash particles floating freely in the atmosphere of the furnace gases assume a spherical shape when they are heated to their liquid phase. These spherical bubbles may contain gas so that they may float in the air longer than solid spheres, in the manner of gas-filled balloons. The liquid particles would act like rain drops.

Three microphotographs are presented showing the form assumed by the ash particles in the burning and passing of the pulverized coal through

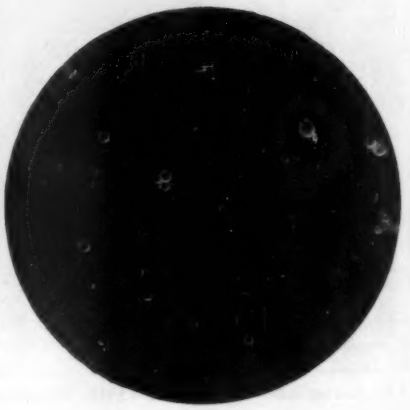


Fig. 3a. Photomicrographs of stack emission; this is 100 per cent fly ash

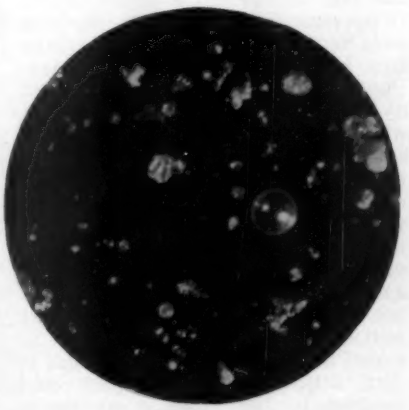


Fig. 3b. Emission from mixture of 50 per cent coal, 50 per cent dirt, sand

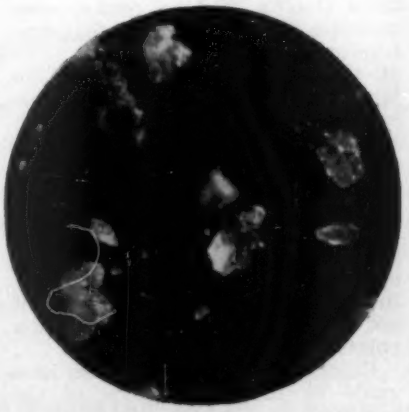


Fig. 3c. Random photo of a mixture of dirt and sand — shown for comparison

Table I. Average intervals between fusion temperatures*

Seam of Coal	No. of Samples analyzed	Fluid point to softening point, deg F FP—SP	Softening point to initial deformation, deg F SP—ID	Total Interval, deg F FP—ID
WEST VIRGINIA				
Chilton	22	51	137	188
No. 5 Block	59	59	106	165
Dorothy	74	60	135	195
Colburg	4	62	116	178
Cedargrove	30	93	86	179
Winifrede	7	98	80	178
KENTUCKY				
Pond Creek	9	55	116	171
Hazard No. 7	11	66	74	140
Hazard No. 4 (a)	5	75	111	196
Hazard No. 4 (b)	6	137	140	277
Darby	4	138	140	278
Elkhorn	19	119	142	261
Jellico	3	250	117	367
OHIO				
Lower Kittoning	12	139	169	308
Pittsburgh #8	31	178	109	287
Hocking #6	5	194	158	352

*F. Reiter and R. Andres, AIME, Charleston, June 16, 1950.

Table II. Some test results of the fusion properties of clinker

Material	FP deg F	Interval FP—SP deg F	SP deg F	Interval SP—ID deg F	ID deg F	Total Interval FP—ID deg F
Coal	2959	63	2866	119	2747	212
Clinker	2696	100	2596	373	2123	573
Drop	−263	+7	−270	+254	−624	+361

Table III. Cinder color characteristics of a high fusion coal

Boiler	Stoker	Color of Cinder	Structure of Cinder
1	Spreader	Generally light tan with many white particles	Soft loose, small pieces, very little compression strength
2	Underfeed, multi-retort, preheated air, normal load	Brown, dark brown in areas	Medium heavy clinker, more cinders, with some compressive strength
3	Same as 2, except heavy load	Dark brown with black areas, especially inside large clinkers	Heavy dense clinkers, glossy in black area

the boiler furnaces. The particles of 100 per cent fly ash portrayed in photo (a) of Fig. 3 are all spherical and look transparent or hollow inside. It appears that all fly ash particles were heated above their liquid points and assumed the spherical shape. Photo (b) of Fig. 3 shows a 50 per cent fly-ash, 50 per cent dirt mixture, wherein many spheres, both white and translucent, are seen among more irregularly shaped particles of dirt. The temperature of this furnace was hardly above the liquid temperature of the fly ash. In these boilers, not all of the true fly ash assume the spherical form. Very high fusion coals are fired into these boilers and many particles come through without fusion. Photo (c) in Fig. 3 is a sample of dirt, with about 50 per cent sand content, photographed at random to compare the shape of its particles with fly ash.

One might use the photomicrographic shapes of the fly ash as a measurement of the furnace temperatures. One hundred per cent spheres indicates that the furnace temperature must be above the liquid point of the ash of the coal. Cyclone furnace fly ash should come in this category. Cyclone furnace fly ash should be very dense, if not wholly solid, because of the very high furnace temperatures maintained relative to the liquid point of the coal ash. Irregularly shaped particles of fly ash would indicate that the furnace temperature might be below the ash softening temperature, if not even the initial deformation points of very high fusion coals.

Color of the ash also serves as a guide to the performance of the burning operation. Prior to determining their fusion properties, the identification of certain coals may be aided by observations of the color of the ash. The ash may be white, reddish, gray, and so on; but one must have a color chart of the ash of many coals available for identification. Knowing the ash fusion temperatures of the coal being fired helps relate the cinders or clinker of a stoker fired furnace with the temperature of the fire.

The same high fusion coal going through three different boilers of the same plant mentioned above gave the cinder color characteristics listed in Table III. It was suspected that the black glassy areas in these samples contained considerable black carbon held within the fused mass. Analysis showed no carbon present. The fused ash, in the practically liquid form, acted like a borax bead and took the iron into solution, imparting the black color to the mass. The frit or resultant ash removed from the water tank that received the liquid molten ash from cyclone furnaces is jet black in color. Cyclone fuels are of the low-fusion higher-iron content variety of coal, with a liquid point of the ash 2500 F or lower, normally higher in iron.

The conclusion drawn from our study of color of the ash and cinders of the spreader and stoker furnaces described above, were:

1. The furnace temperature of Boiler No. 1 was below the ash softening temperature of the ash of the coal. No inter-reactions of any metallic oxides and the refractories occurred, as indicated by the mixture of light tan and white particles that were distinctly clear and visible.

2. The furnace temperature of Boiler No. 2 was at or slightly above the ash softening temperature. Some plasticity of the ash occurred in forming cinders of some size. Some primary chemical combinations had taken place to form the dark areas.

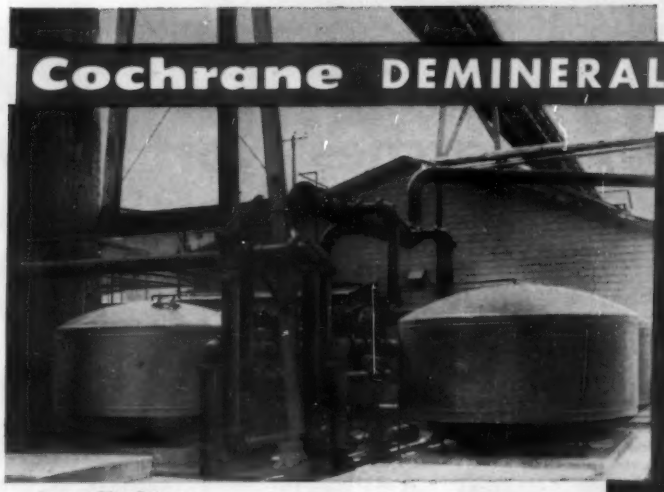
3. The fuel bed temperatures were above the liquid point in areas, producing secondary fusion reaction and solution of iron oxide in some of the liquid parts of the ash, as indicated by the black glassy clinkers.

The effects of the relative furnace temperatures on the color of the fly ash of pulverized and cyclone fired furnaces is illustrated by the color of the fly ash emerging from the stacks. Although the fly ash emission from the stacks of cyclone furnaces is much less than that of standard pulverized furnaces, the high furnace temperatures of the cyclone combustion zone, relative to the liquid point of the ash of the coal fired, tends to darken the fly ash particles, probably by the same solution of the iron oxide reaction in the small glass spheres as described above.

Glass Bubbles Make Tough, Versatile Insulating Wall — Correction

IN ARTICLE of above title, page 88, April issue, column 2, paragraph 2, line 10, a slip of the typewriter inserted the word "Duraglas" instead of the correct word "Foamglas." The sentence, therefore, should read "When a double course wall is to be laid, the manufacturers suggest Duraface blocks for the exposed surfaces and Foamglas for the concealed course." Please mark your copy to read as corrected.

Cochrane DEMINERALIZERS



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Two-Way Radio Dispatches Norton's Thermos-Bottle Locomotives

When Hurricanes Carol and Hazel got through with the Norton Co.'s communications system, little was left. Emergency radio was installed in their yard equipment to help them over the hump, but it worked out so well they decided to keep it. It's a money-saver

Fig. 1. "Radio control" of switch engines first was necessary, then became popular at the Norton Company in Worcester, Mass. Engine is charged with h-p steam daily

Figs. 2, 3 and 4. A central dispatcher can reach any of six trucks and two locomotives from his office, or can direct operations from a portable field radio

AMONG the many duties of the power engineer at the Norton Company, Worcester, Massachusetts, is charging the two fireless cookers. Fireless cookers to the uninitiated are railroad locomotives well insulated but with no means of generating steam. They are charged with high pressure steam from a boiler plant and operate on this storage battery effect throughout the day until they are unwound and again recharged.

At the Norton Plant two of these fireless cookers handle incoming and outgoing freight over six miles of tracks throughout the plant. They are now radio controlled, an aftermath, let us say, of the Hurricanes Carol and Hazel. These hurricanes destroyed the normal communications system. The Norton Company realized that a reliable and portable communication system was needed. Six trucks and two locomotives were equipped and are now directed by radio from a Central Dispatching Office.

While the equipment was installed as an emergency measure, it was quickly adapted to everyday operation and the company is still finding new ways to save time with it. The saving in man-hours has been substantial; where formerly three or four repairmen would have to wait 15 or 20 minutes for a truck to pass on its regular bus route, now they call a dispatcher and often a truck is waiting for them before they get from the telephone to the rendezvous point.

From the fireless cooker standpoint, car weights can be radioed from the car scale to the dispatcher providing almost instantaneous information to those who need to know. Likewise the number on incoming cars can be reported as soon as the locomotive picks up the incoming cars at the car entrance.

Recently a car was derailed at a switch and the yard locomotive was too low on steam in its "thermos bottle" to pull the car back on the track. The car was between the locomotive and the barn. The engineer called for a second locomotive to be brought from the charging station at the power house and in a short time the track was clear again.

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Power Engineering handbook

Make Pipe Turns the Easy Way With This Home-Made Template

ACCURATE marking of pipe for making turns in welded piping can be a long job, and anyone who has to work on piping construction and replacement can make good use of the set of templates described here for laying out turns for welded pipe. Figures A1 and 1B show a finished template.

These templates are very easy to make. First, it is necessary to figure out the angle of the particular bend required. In this article we have confined ourselves to discussing 90-deg bends in a variety of pieces, as shown in Fig. 2. Then the template is simply slipped over the pipe, positioned, and the line of cut marked off with chalk or soapstone.

The template consists of two pieces of composition board or plywood cut to fit snugly around the pipe. When closed, the cutouts form a circle of the same diameter as the pipe. When opened, the template can be tilted and made snug to the pipe at almost any angle. Figure 8, for example, shows the template snug against the pipe at a 45-deg angle.

While the sketch (Fig. 4) shows a template that was made for a 6-in. pipe, the same directions can be employed in making templates for any size pipe. The dimension of the opening at "A" is the really critical dimension and this is obtained simply by adding ⅛ in. to the outside dimension of the particular pipe for which the template is being made. All other dimensions, of course, are variable at will to fit the conditions. So, if a shop is regularly working with

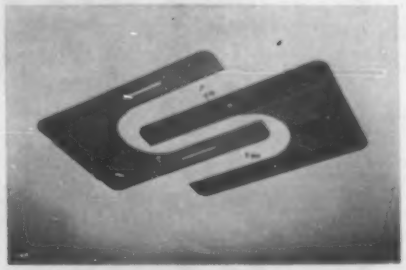


Fig. 1A. Two pieces of pressed board comprise the basic template. Slots in one piece allow fitting

Fig. 1B. Positioning plate (at left of opening) establishes angle of intersection by the template

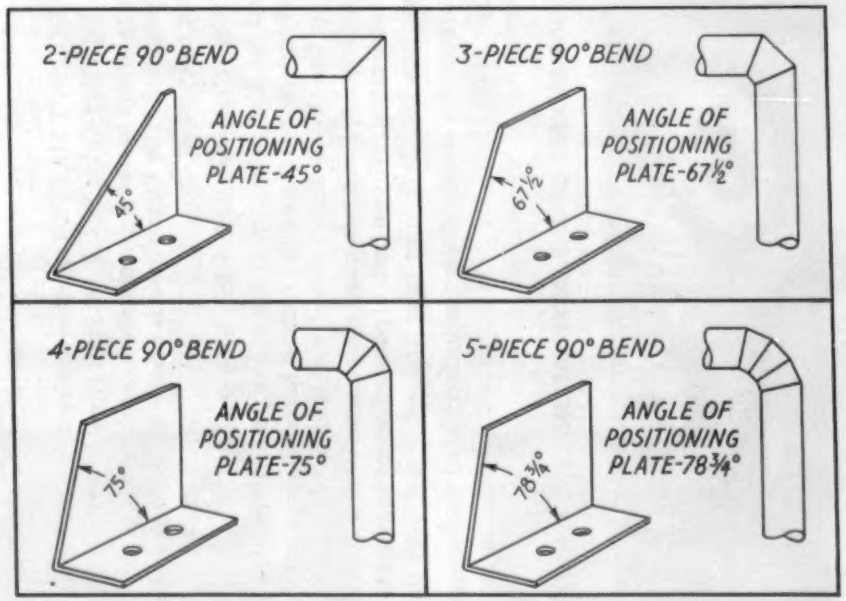


Fig. 2. Typical positioning plates which can be interchanged on template boards for all pipe diameters

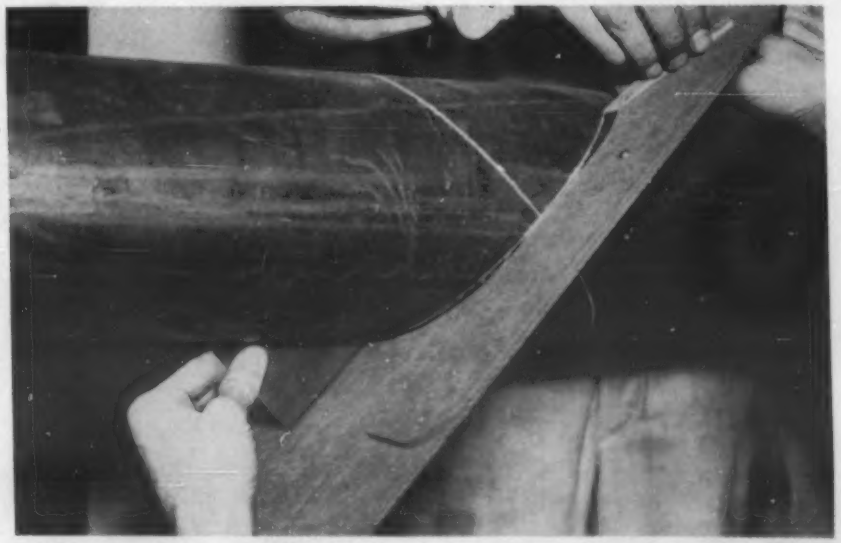
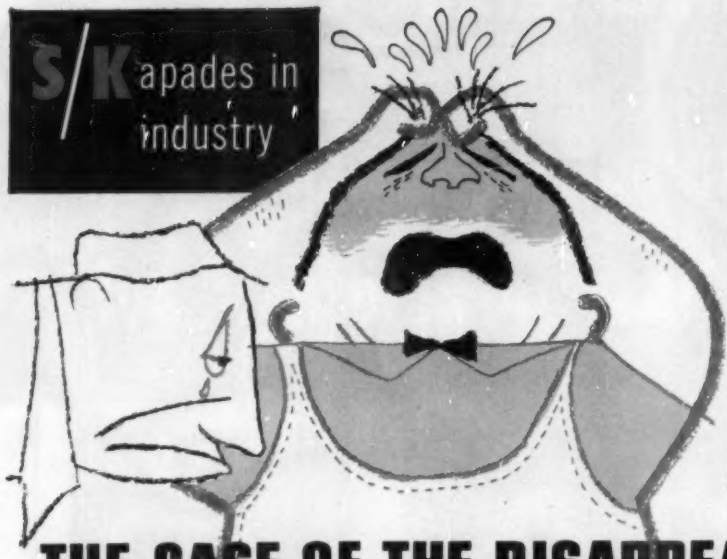


Fig. 3. With template snugly fitted at 45 deg, the pipe is marked either for a 2-piece 90-deg turn, a 90-deg cross, or a 90-deg "T" joint. Soapstone is held flat to template face and should be sharpened

S/Kapades in industry



Buck, the Boss Boiler Expert, had red hair and a vivid green complexion. The complexion came from bilicusness—caused by disappearing tube bundles in acid-oil and liquid-sludge heaters.

"Wurrrp!" said Buck to his Assistant. "Another tube bundle chawed up by corrosion. We work night and day installing new tubes, sheets and baffles—and they disappear like pie at a picnic."

"And management keeps squawking about heater downtime," said the Assistant. "*And* overtime. *And* retubing costs. Boy, is your face green!"

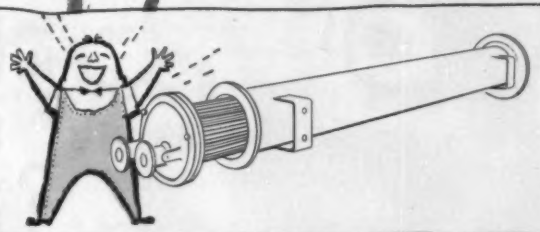
"Beeeep!" said Buck. "Yours will be red if we don't find a way to lick this corrosion problem."

"I think there *is* a way," soothed the Assistant. "Let's go look at a catalog I just got from Schutte and Koerting."

THE CASE OF THE DISAPPEARING TUBE BUNDLES AND THE BILIOUS BOILER EXPERT

Schutte and Koerting Bulletin HT-1, "SK Heat Transfer Apparatus," told Buck just where he could get information about various types of tube bundles. Special materials, sizes, types and modifications—all were covered. "Let's suggest that management call an SK Sales Engineer," said Buck.

The SK Sales Engineer arrived on the double. He took a good look at the corroded tube bundle, asked some pointed questions about materials to be handled, and made some recommendations that caused even the Big Brass to applaud.



CORROSION CONQUERED—BILIOUSNESS BEATEN.

At the SK Engineer's suggestion, new tube bundles of Copper-Silicon Alloy replaced the old bundles in liquid sludge heaters. Result: long, trouble-free operation in processing highly corrosive stock—far less downtime and lower retubing costs—a brand new complexion, not even tinged with green, for Buck, the Boss Boiler Expert!

MORAL: *Send today for your free copy of SK Bulletin HT-1 on Heat Transfer Apparatus. And for skilled help with a specific problem, call in a specialist—your nearest SK Sales Engineer.*

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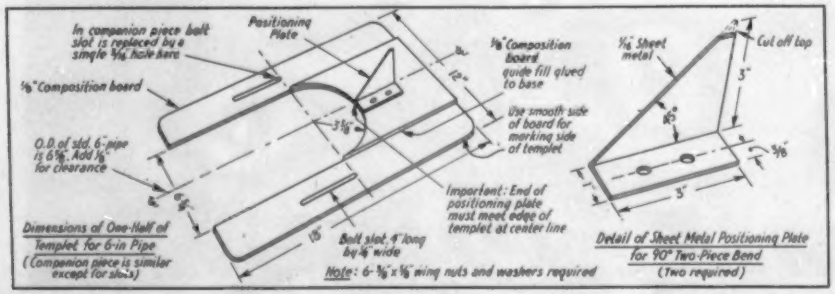

In companion piece bolt slot is replaced by a simple ¾" hole here
Positioning Plate
⅛" Composition board
O.D. of std. 6" pipe is 6⅝". Add ⅛" for clearance
⅛" Composition board guide fill glued to base
Use smooth side of board for marking side of templet
Important: End of positioning plate must meet edge of templet at center line
Dimensions of One-Half of Templet for 6-in Pipe
(Companion piece is similar except for slots)
Bolt slot, 4" long by ¼" wide
Note: 6-⅜"x1½" wing nuts and washers required
¼" Sheet metal
Cut off top
Detail of Sheet Metal Positioning Plate for 90° Two-Piece Bend
(Two required)

Fig. 4. Construction details for template. Note: Add thickness of board to diameter of pipe opening

pipe of two or three different diameters it would be well to make templates for each size of pipe.

First step in using the template is to determine the centerline of the pipe to be marked. Block the pipe up well so that it will be stationary. Then, with a square and level, mark the center of the pipe as shown in Fig. 5. Without moving the pipe, make several other marks at intervals along the pipe. Then draw a line through these points and you have the centerline.

To make a 90-deg bend as shown in Fig. 3, slip the template over the pipe, place the positioning plate flat on the surface of the pipe and along the centerline. Draw the two parts of the template together and tighten the wing nuts. Next, hold the template steady and lay out the cut around the pipe by sliding a flat soapstone, or chalk, along the template surface. Next, the pipe must be cut. Make a miter cut by holding the blowpipe in the same position as you would a saw. After cutting, bevel the edges to the cut ends to form a vee for welding. This is best done by holding the blowpipe at an angle of about 30 to 45 deg and moving it toward you. Then, rotate one section of the pipe 180 deg and make the weld. Melt both edges of the pipe joint all the way to the inside wall.

For this information and the illustrations we are indebted to F. C. Geigig, Development Engineer, The Linde Air Products Co.

Fig. 5. To locate centerline, use soapstone to bisect two legs of square; be sure square is vertical

fold along this line—outside edges toward you

Pipeline Moves Above Ground to Solve Corrosion Problem

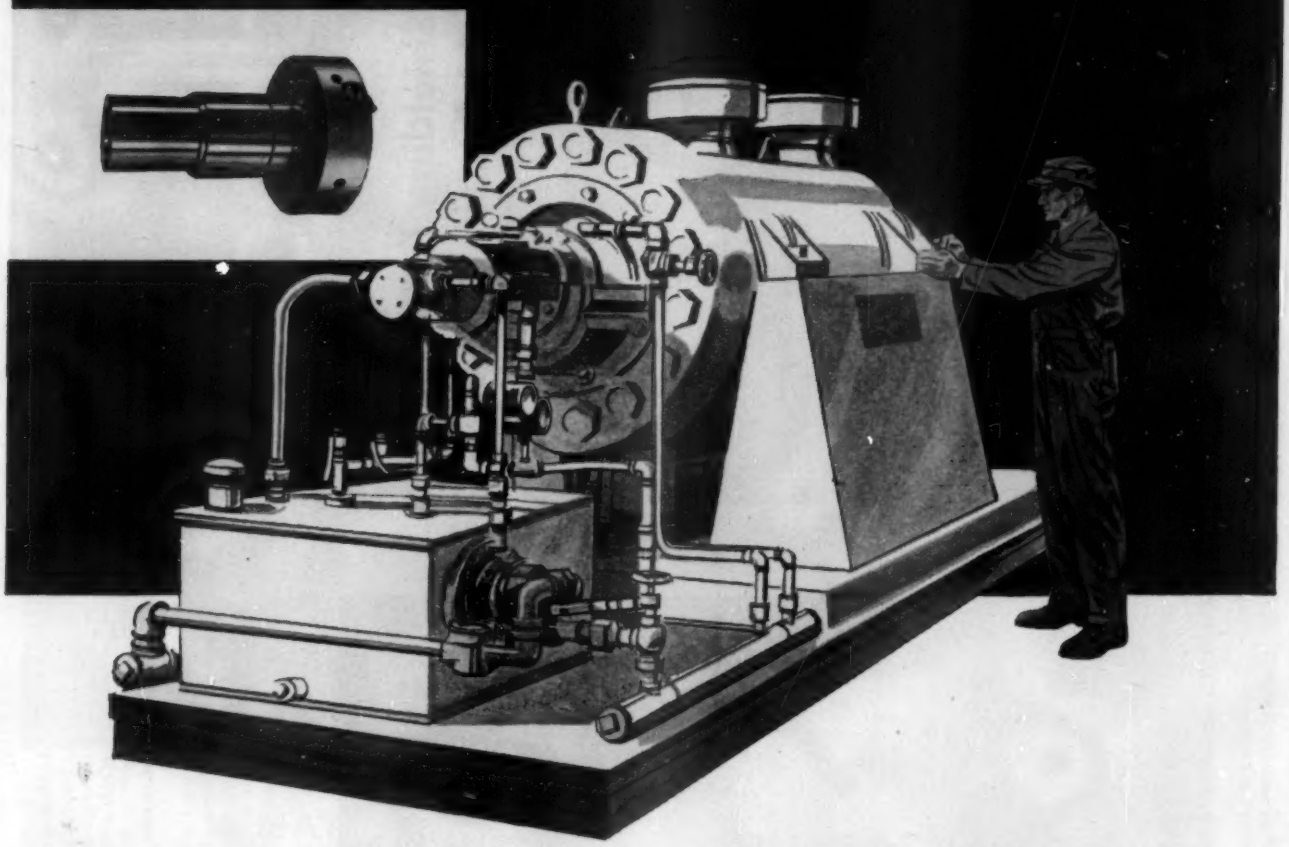
By AUGUST W. SIEWERT

New pipeline to replace corroded underground line is "floated" on these short lengths of cross-tie

THIS return line was once underground, but corrosion troubles caused us to relocate it as shown above. Our trouble with the underground line may have been caused by incomplete tar coating over the welded pipe, or it may have been due to damage to the tar coating applied over the outside shell. In either case, ground water attacked the outside shell and let water into the insulation blanket. Once there, it attacked the pipe surface from the outside and made numerous pinholes. Some of this line lasted about three years, some ten years, and some has been in since 1941.

When we replaced the 300-ft section shown above, we began by buying creosoted railroad ties and cutting them into three-ft lengths. We then installed the two-in. pipe and covered it with magnesia insulation and a roofing material jacket. Galvanized metal U-shaped bands fasten the assembled line to the cross-ties, which in turn are free to "float" on the ground with movements due to temperature changes. This arrangement serves our purposes well.

Now... BJ mechanical seals for high pressure boiler feed pumps!



Another Byron Jackson first!

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- **Stop liquid loss**
- **Reduce heat loss**
- **Save downtime costs**
- **Cut replacement costs**

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Power Engineering handbook

Internal Gas Shielding Replaces Pipe Weld Backing Strips

FORMED structures of such hard-to-weld, but industrially important, materials as titanium, "super alloys," aluminum, or air hardening steels can now be fabricated readily with complete penetration, controlled contour welds — free of a major cause of failure in welded joints, root bead cracking. In this new process of welding high strength metals, precise control over the application of the root bead — the all-important initial bond between welded joints — is integral to the process itself rather than being dependent upon the skill of the operator, previously a determining factor.

Reducing the human element is a considerable advance in eliminating the critical problem of lack of penetration. Today's growing application of inert gas shielding — to the root bead's interior surface — has been an important step toward assuring complete penetration and producing completed welds of high quality. However, attaining full penetration in single V-butt welds, from one side without backing rings, has depended upon outstanding operator skill . . . a skill which cannot be maintained at high levels of performance without excessive physical strain.

Where penetration is incomplete, there is also the unfortunate possibility that it may not be detected by available non-destructive examination. In ferritic materials, magnetic powder examination is also limited. Lack of penetration, even of minute dimension, interrupts an inside contoured surface with sharp notches.

With this new welding process, developed by The M. W. Kellogg Company these disadvantages are offset since the control of penetration is inherent in the process. Through precise control of technique, physical dimension and internal gas shielding pressure, the process produces root beads of assured full penetration and controlled internal contour, a uniform root bead surface free of undercutting, and a high degree of root bead reinforcement — without backing rings and with only average operator proficiency.

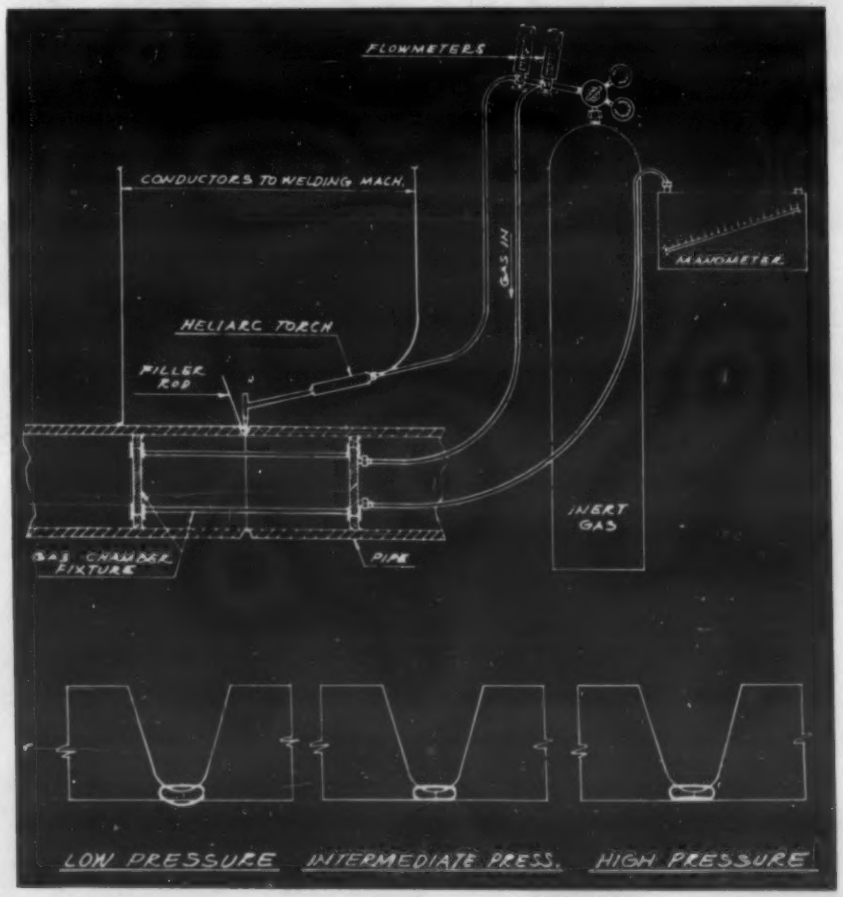
The illustration shows the inner and outer inert-gas shielded arc welding as used in applying the initial or root bead to the joint being made up. By accurately controlling gas pressure inside the pipe or weldment, a weld is deposited in this process with a highly uniform internal contour. By varying gas pressure, the inner surface of the bead can easily be made slightly convex, flush, or even concave — although the latter would rarely be used since it results in reduced weld strength.

The weld quality obtained by this process meets all x-ray, physical, and mechanical requirements of the ASME Boiler Code, and other codes and specifications. Tensile, bend, impact and torsion tests have demonstrated excellent properties. Complete metallography has revealed that there is no tendency for cracking or under-cutting the edges of the inside bead.

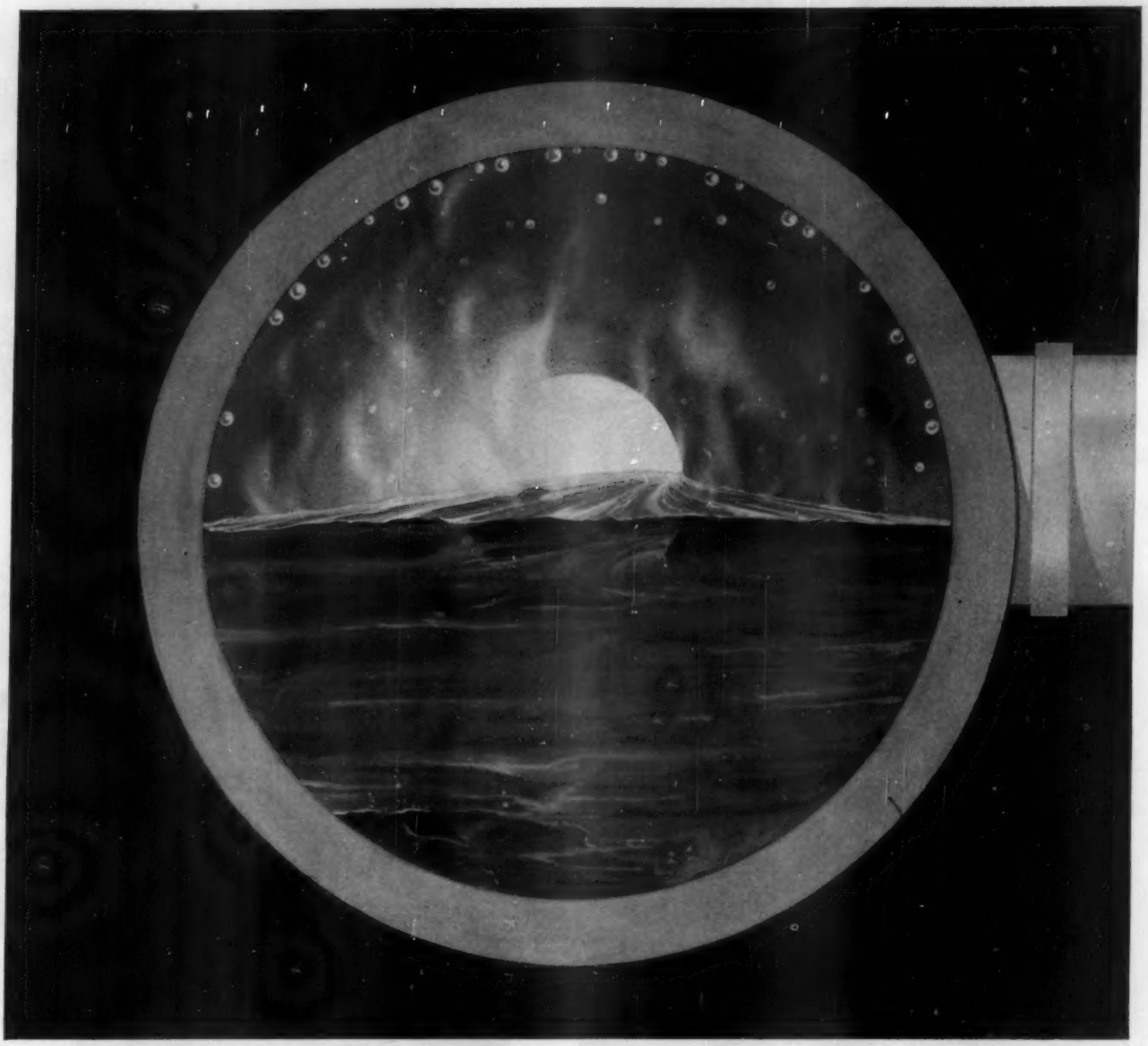
Although first used commercially in the shop fabrication and field installation of high pressure, high temperature stainless steel power piping, the process is being applied successfully to many other difficult welding applications. It is applicable to any metal or alloy which can be fusion welded. Welds produced by this process in heat-treatable steels such as SAE 4130 have withstood, without cracking, the drastic quench necessary to produce yield strengths in excess of 150,000 psi. Other materials welded successfully by this process are carbon and carbon molybdenum steels, chromium molybdenum steels, nickel, monel, inconel, and copper.

Data and illustrations courtesy of M. W. Kellogg Company

fold along this line—outside edges toward you



Small bulkheads fitted on both sides of the weld allow control of pressure inside pipe to give root conditions as shown in bottom diagrams. This technique reduces level of skill needed to apply a root bead



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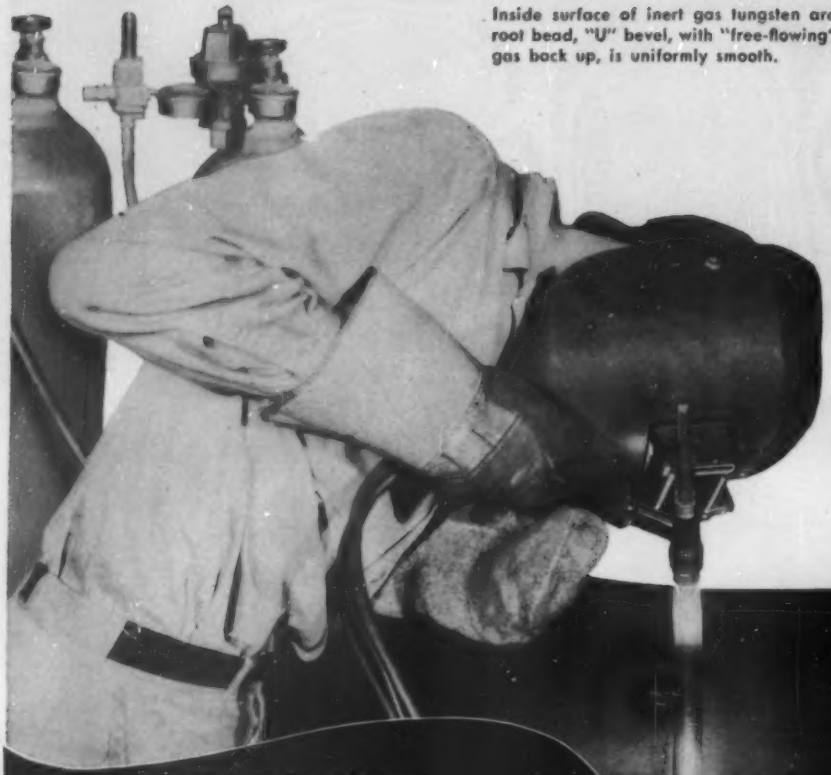

Inside surface of inert gas tungsten arc weld root bead, "U" bevel, with "free-flowing" inert gas back up, is uniformly smooth.

Here's How *Pittsburgh Piping* uses Inert Gas Tungsten Arc-Welding on Turbine Piping

Turbine pipe, 2¼% Chrome–1% Moly steel, is preheated before making root pass.

Inert gas tungsten arc-welding, a standard production operation at Pittsburgh Piping, is used for the root pass on high-temperature, high-pressure piping.

U-grooves are precisely machine tool cut on pipe ends . . . the ends are accurately aligned and butted, ferritic materials preheated to desired temperature, then tack-welded.

Air inside the pipe is displaced with "free-flowing" inert gas and the root pass is made at a uniform rate, at comparatively low voltage, using a tungsten electrode shielded with inert gas. The weld is then thoroughly inspected for uniformity and soundness.

Conventional arc-welding methods are used to complete the weld, the connection is stress-relieved, and then thoroughly inspected by special non-destructive tests. This procedure, combined with other P.P.&E. techniques, eliminates need for backing rings and double butt welding, and produces a sound, clean joint having a remarkably uniform root bead of correct internal contour.

Pittsburgh Piping

AND EQUIPMENT COMPANY

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PP-7

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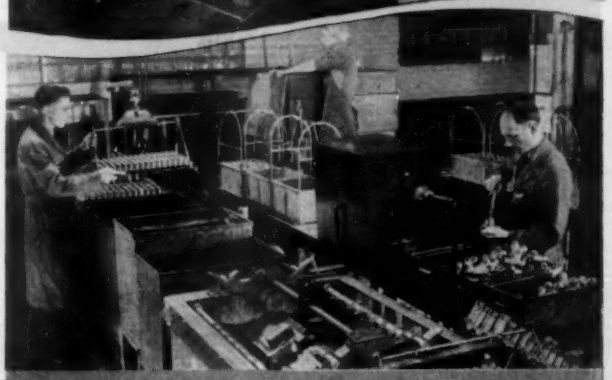
HOW EVALIZING* CUTS VALVE WEAR, GALLING AND FREEZING IN ROCKWELL-BUILT EDWARD VALVES

PROBLEM: In practically all steel valves there are some steel parts which must turn or slide freely in contact with other steel parts. But in many services, frequent operation, wide temperature and pressure variations and other factors result in wear and galling or binding between the parts. Operation of the valve becomes difficult.

In special machines, built to Edward designs, Edward engineers have tested thousands of metal specimens for wear and galling or seizing characteristics. Electric furnaces make possible elevated temperature tests when desired. The general problem of abrasion has been under study in the Edward laboratories on such equipment for decades.

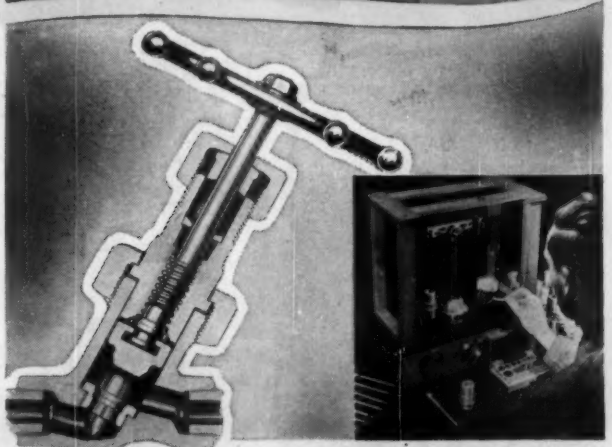
SOLUTION: One Edward answer to abrasion is EValizing,* an exclusively Edward process for coating steel valve parts with a bearing material which reduces friction between moving steel parts by about 25 per cent. It is applied electrolytically to such parts as the internal stem threads of all inside screw forged steel valve bonnets, junk rings, packing nuts, and, in the case of large high temperature, high pressure valves, the nuts used in body-bonnet bolting.



Section of the Edward EValizing department. Special fixtures permit plating of inside screw threads.

RESULT: Edward makes wide use of EValizing and the dividends are in much longer valve life and easier valve operation. For instance, long time tests show that a stainless steel stem can be rotated nearly 1000 per cent more in an EValized bonnet than an ordinary unprocessed steel bonnet. EValizing is a standard feature for many Edward valve parts, and is especially important on such valves as Fig. 2698 forged steel globe valve, right. Built in ¼ in. to 1 in. sizes, screwed or welding ends, and with a companion angle design, this low-cost, all-purpose valve is ideal for a multitude of services.

*Trade-Mark Registered



Widely used Edward Fig. 2698 forged steel stop valves showing areas regularly EValized.

After long service careful checks of EValized and non-EValized bonnets have been made. Loss in weight due to wear in Evalized bonnet approximates ½ that of normal untreated steel bonnet.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
1202 W. 145th ST., EAST CHICAGO, INDIANA

For more information on Rockwell - Built Edward Cast and Forged Steel Valves write for the Edward Condensed Catalog.

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Why is the fireman always poking at the fire today?

We have a new lot of coal and it clinkers badly. He's digging the clinkers out and covering up holes in the fuelbed.

Don't holes in the fuelbed make clinkers?

They sure do! And the air required for combustion goes through these holes and we can't keep the steam pressure up.

Why did we buy such coal?

Well, it was a few cents cheaper and we didn't consider the analyses so nobody realized it had such a low clinkering temperature.

So we save pennies on the coal and blow dollars up the chimney!

Yes sir! That's about the size of it. But just as soon as this lot is used up, we're going back to the old coal. That was specified for us by the Chesapeake and Ohio Fuel Service Engineers to give us the lowest *steam cost* with our type of stoker and boiler. We should have stuck with the coal they recommended – it never gave us a bit of trouble.

P.S.

There's a lot more to buying coal than the cost per ton. For facts and figures to solve your particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

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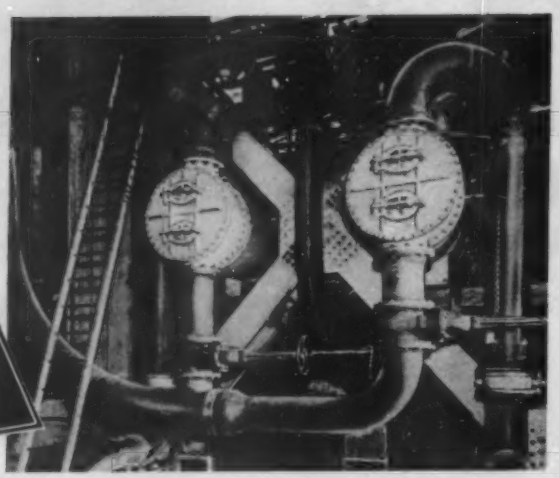
performs better costs less to maintain

Conseco Condensate Coolers for hydrogen cooling installation in large utility. Note quick-opening doors for tube sheet inspection. Units are two-pass channel type.
Courtesy Public Service Electric and Gas Co.



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of practically all other makes of condensers, heat exchangers, pressure vessels, steam jet air ejectors, and other power and processing equipment. This experience in repairing, rebuilding, and modernization is applied by our manufacturing division in the design and production of Conseco Equipment.

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Condenser Test

continued from page 94

leaks. Before doing this, install a manometer at the top of the waterbox to measure waterbox internal pressure. Throttle the discharge only until the manometer indicates a slightly positive pressure. This procedure is necessary as waterboxes are not normally designed to withstand more than 20 psi differential pressure and may not be safe at even lower pressures for a particular unit.

Undoubtedly, the most difficult and expensive maintenance encountered in connection with condensers, short of completely re-tubing, results from the improper erection or failure of steam side baffles and seals. In most condenser designs, steam baffling is employed to protect the air cooler section from receiving steam that has bypassed the main tube bank. Almost invariably part of the baffles cannot be reached for inspection without removing a large number of tubes. Great care should, therefore, be taken to assure that all baffles and seals are properly and firmly welded in place during initial erection and on re-tubing.

As a final check, make sure that relatively warm water from the condenser discharge is not being recirculated back into the intake line. Increase of circulating water temperature by even one degree F will result in a noticeable decrease in condenser vacuum.

Before conducting tests on a condenser, make certain the vacuum gage is not only correctly adjusted, but that there are no leaks in the instrument line between condenser and vacuum gage. The smallest leak in the instrument line will cause a false and substantially reduced vacuum reading.

OBITUARIES

Henry V. Nye

Henry V. Nye, retired consulting engineer for switchgear equipment at Allis-Chalmers Manufacturing Co., died February 28 at his home in Milwaukee. He was 69 years old.

A veteran of 48 years of service with Allis-Chalmers, Nye joined the company in 1906 after graduating as an electrical engineer from Iowa State College.

For many years Nye was engineer-in-charge of switchgear design at Allis-Chalmers. He was appointed consulting engineer in 1949, a post he held until his retirement in 1954. He was a fellow of the AIEE and had been active on various of its committees.

W. A. Roberts

W. A. ROBERTS, president of Allis-Chalmers Manufacturing Co. since February, 1951, died suddenly April 12 following a heart attack. He was 57 years old.

Mr. Roberts began his career with Allis-Chalmers in 1924 as a salesman for the firm's tractor branch in Wichita, Kan. In 1926, the company transferred him to Canada as Canadian sales representative.

W. A. Roberts

Mr. Roberts came to the company's Milwaukee headquarters in 1930 as agricultural sales manager of the tractor division. The following year he was advanced to general sales manager. During the next 10 years under Roberts' sales leadership the tractor division's growth was remarkable.

In March, 1944, Mr. Roberts became vice president in charge of the company's tractor division. He was elevated to executive vice president in charge of that division in 1947. In January, 1948, he became a director, and in March, 1948, a member of the board's executive committee.

Under Mr. Roberts' direction, Allis-Chalmers has about concluded an expansion program totalling more than $100,000,000. Several factories were expanded and modernized.

Mr. Roberts was a member of the President's Advisory Committee on the National Highway Program, the National Industrial Conference Board, the National Committee on Boys and Girls Club Work, Inc. He was a former president and member of the executive committee of the Farm Equipment Institute and an officer of American Road Builders Association and National Safety Council.

In addition to his affiliation with numerous other trade groups, Mr. Roberts was a member of the Wisconsin Turnpike Commission, the board of governors of Marquette University, the executive committee of the Greater Milwaukee Committee, the committee for Co-Ordinated Hospital Planning in Milwaukee County, and vice president of the United Hospitals Fund of Milwaukee County. He was also a director of the First Wisconsin National Bank and a member of the board of West Allis Junior Achievement.

On Induced Draft Fan Casings—Where previously repairs required heavy, abrasion-resistant steel plates, now a coating of Super #3000 provides safe protection for many months against the scouring action of fly ash.

On Inside Duct Lining—A ¾" thick layer of Super #3000 over the insulation provides long-life refractory lining that withstands erosion of hot abrasive gases.

On Boiler Tubes — By painting the tubes in the passes of the boiler with a thin mix of Super #3000, considerable protection is provided against erosion.

There are a great many more reports of Super #3000 success—where other refractory mortars have failed quickly and utterly—in boiler walls and arches, coke oven floors, furnace linings, etc.

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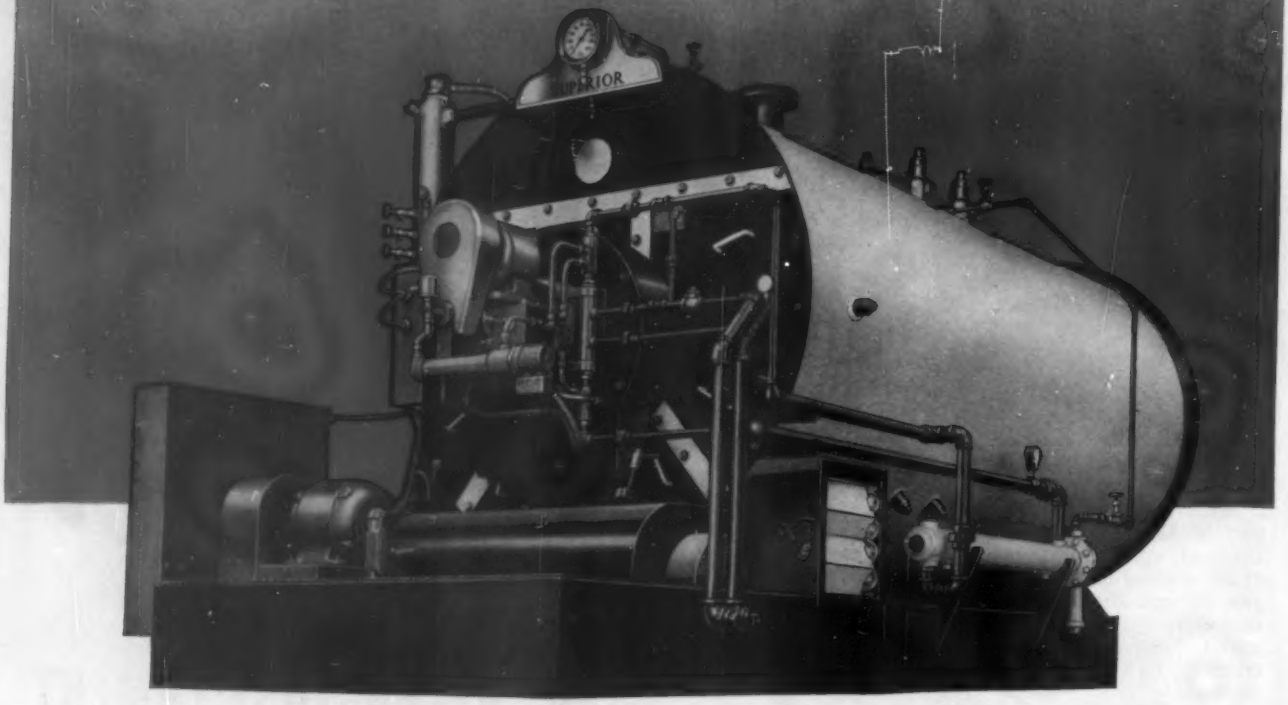

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Standard catalogs listed monthly to help you maintain a reference library

COAL, ASH HANDLING

201 **Economic Coal Storage** — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

202 **Automatic Coal Scale** — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

203 **Spreader Stoker Data** — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

204 **Spreader Stoker Selection** — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

It's easy to get these free catalogs—just circle item numbers of those wanted on the post card at right.

205 **Pneumatic Handling System** — Of value to power engineers concerned with the handling of dry pulverized materials, 16-pp Bulletin G-2 tells how handling costs can be reduced by using the proper pneumatic handling system. Lists 86 dry pulverized materials and indicates which of three systems is best suited to handle each material. Discusses company's system for conveying such materials as Portland cement, coal. Fuller Co.

206 **Burning Bituminous Coal** — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

207 **Fly Ash Collection** — The successful and economical separation of fly

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107	108	109	110	111	112	
113	114	115	116	117	118	
119	120	121	122	123	124	
125	126	127	128	129	130	
131	132	133	134	135	136	
137	138	139	140	141	142	
143	144	145	146	147	148	
149	150	151	152	153	154	
155	156	157	158	159	160	
161	162	163	164	165	166	

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201	202	203	204	205	206	207	208	209	210	211	212
213	214	215	216	217	218	219	220	221	222	223	224
225	226	227	228	229	230	231	232	233	234	235	236
237	238	239	240	241	242	243	244	245	246	247	248
249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272
273	274	275	276	277	278	279	280	281	282	283	284
285	286	287	288	289	290	291	292	293	294	295	296
297	298	299	300	301	302	303	304	305	306	307	308

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501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521
522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542
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ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Western Precipitation Corp.

208 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March Corp.

REFRACTORIES

209 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Charts and tables afford easy reference. Universal Atlas Cement Co.

210 Refractories for Heat, Power — Compiled to help power engineers solve refractory problems and get greater operating efficiency from their boilers, this booklet provides 32 pp of practical information on company's Crystolon refractories. Properties and characteristics of these silicon carbide products are given and separate chapters cover those for air-cooled, solid wall and water tube protection, and for repairs. Norton Co.

211 Refractory Notes — Included in Vol. XV of this company's Thermogram is an illustrated article on a method for degreasing hot topping costs in steel mills with minimum capital expenditure. Another story tells how bonded brick assemblies cut installation time in a coke plant. Refractory & Insulation Corp.

BOILERS, GENERATORS

212 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

213 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

214 Shop Assembled Boilers — Two-drum, bent tube package units for steam and high pressure and high temperature hot water are the subject of this illustrated bulletin. Gives construction details, dimensions, ratings. Springfield Boiler Co.

215 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam

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generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

216 Automatic Boilers — This bulletin describes 17 sizes of Powermaster packaged automatic boilers from 15 through 500 hp for steam process, steam and hot water heating service. Lists such advantages as three-pass design, forced draft and automatic controls. Describes firing equipment for light and heavy oils, gas; shows various fuel firing arrangements. Orr & Sembower, Inc.

217 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

218 Steam Generator — This manufacturer's new Type D steam generator, a packaged unit for pressure firing with gas, oils or combination of fuels, is described in an 8-pp catalog. Gives complete data and dimensions on this water tube generator which is available in 17 sizes with capacities from 8000 to 40,000 lb of steam per hour. Fully illustrated, booklet explains economical steam production, low installation cost, other advantages. Superior Combustion Industries Inc.

TUBING AND ACCESSORIES

219 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Gives details on proper installation. Scovill Mfg. Co.

220 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

221 Data on Stress Values — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

222 Nickel Pipe and Tubes — Bulletin T-17 is a 28-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

223 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Air valves, hose, lubricators are described. Thomas C. Wilson, Inc.

VALVES, TRAPS, PIPING AND ACCESSORIES

224 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

225 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

226 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

227 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum

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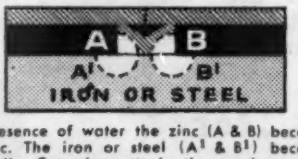

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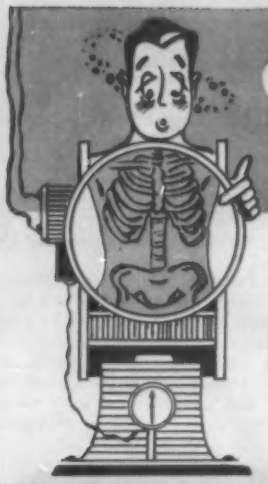

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pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

228 Regulating Valves — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

229 Blow-Off Valves—Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and double-tightening blow-off valves. Gives full ordering data. Yarnall-Waring Co.

230 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are also discussed and the importance of stem operation is treated. Crane Co.

231 Steel Gate Valves — Five types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 B, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

232 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

233 Industrial Valves — Condensed Catalog 105, 28-pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

234 Steam Trap Solutions — Bulletin F.151, 36 pp, is a newly revised edition of this company's well known booklet, "Solving Steam Trap Problems." Organized for easy reference, this illustrated booklet provides specifications and capacities of steam and float traps, air release valves, pipe line strainers. Tells how to calculate condensation loads and select traps for unit heaters, jacketed kettles, submerged surfaces. Gives pointers on installing and servicing traps. The V. D. Anderson Co

235 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

237 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

238 Welded Fittings — Catalog 3 is a 36-pp ordering and engineering reference book on company's Weldolets for piping services. Gives data on butt-welding and socket welding Weldolets as well as on Thredolets for making threaded outlets. Typical installations are pictured; sizes, weights and prices provided. Also included are installation instructions and a technical section. Bonney Forge & Tool Works.

239 Fittings, Piping Handbook — Catalog 55, 304 pp, provides dimensional data and specifications on seamless welding pipe fittings, forged ASA flanges, large diameter and TEMA flanges, as well as screwed and socket welding fittings. Includes a technical data section featuring allowable stress and P/S tables, maximum allowable working pressure charts, also tables covering latest provisions of applicable piping codes and standards to assist in solving piping problems. Book is available to qualified power engineers; please state your job title. Ladish Co.

241 Improved Pipe Hanger — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. National Valve & Mfg. Co.

PUMPS, PUMPING

242 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. De Laval Steam Turbine Co.

243 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

245 Sump Pump Selector — Bulletin 54-3-1420, 20 pp, provides a selection table allowing a power engineer to choose any of the 4000 models of the BJ Sumpmaster pumps, which range from 10 to 2600 GPM with heads from 20 to 300 ft. Includes complete dimensions and outline drawings. Byron Jackson Co.

PACKINGS, GASKETS, SEALS

246 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for many applications. Packing Div., Raybestos-Manhattan, Inc.

247 O-Rings for Sealing, Gasketing — Catalog AD-148, 20 pp, describes

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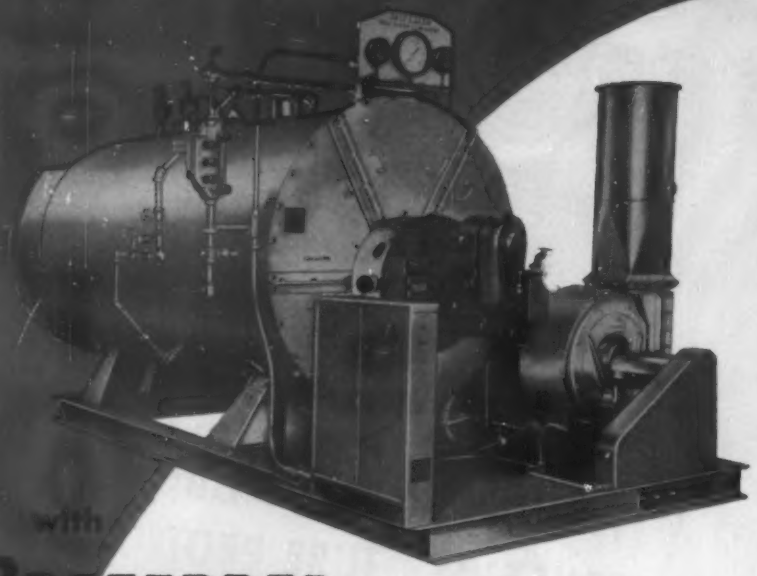

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company's O-rings for sealing and static gasketing. Gives design information, recommended pressures, and available materials for both dynamic and static applications. Also lists standard O-ring sizes. The Garlock Packing Co.

REFRIGERATION AND AIR CONDITIONING

249 Refrigerator Condensers— Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for condensers. Henry Vogt Machine Co.

250 Technical Refrigeration— Twelve-pp Bulletin 754 covers a complete line of environmental testing and processing equipment. Provides illustrations and specifications on recently redesigned altitude, humidity, low temperature and pre-fabricated test chambers as well as specialized testing equipment. Includes helpful engineering data. Bowser, Inc.

251 For Climate Control — Bulletin 122, 8 pp, introduces an air conditioner designed for precise and economical control of air temperature and moisture. Illustrates design of the new machine, tells its features, and pictures some installations. Niagara Blower Co.

BURNERS

252 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. Specifications included. The Engineer Co.

253 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

ELECTRICAL EQUIPMENT

254 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control. Allis-Chalmers Mfg. Co.

255 Motor Lubrication—Three methods of lubricating electric motors — cartridge, standard open and company's Lubriflush — are compared in 8-pp Bulletin 1848. To demonstrate action of relubrication in Lubriflush bearings, a series of natural color photos of a transparent bearing housing is reproduced. Necessity of

annual lubrication is demonstrated photographically. U. S. Electrical Motors Inc.

257 The Answers on Wiring — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

258 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

WATER CONDITIONING

259 Handbook on Demineralizing — Bulletin 5800, 39 pp, on treating water by demineralizing, explains principle of ion exchange. Discusses applications of many anion and cation exchange materials; series of curves help estimate cost of operation. Describes design and operation of demineralizer systems, multi-stage systems and mixed bed units. Includes curves of water quality obtainable. Cochrane Corp.

260 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

261 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

262 Water Conditioning Data Book — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

264 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

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INSTRUMENTS AND CONTROLS

266 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

268 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater automatically. Copes-Vulcan Div., Continental Foundry & Machine Co.

2,0 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

271 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

2,2 Steam Calorimeter — This bulletin discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains construction and operation of unit. Ellison Draft Gage Co., Inc.

273 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

OTHER EQUIPMENT

275 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

276 Steam Accumulator — How the steam supply and demand can be balanced by means of company's steam accumulator is told in Bulletin RA-52-8. Stresses reduced boiler capacity required and increased boiler efficiency afforded by use of the accumulator, other advantages. Discusses operating principle, tells how to figure capacity. Foster Wheeler Corp.

277 Turbine Speed Control — Thirty-pp wire-wound Bulletin H-21 is titled, "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic

speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

Postage-free cards for ordering these catalogs are provided on pages 117-118

279 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants; and the life expectancy of bearing lubricants. The Texas Co.

280 Insulating Material — Ultrafine, a thermal and acoustical insulation made of blown glass fibers, is presented in this bulletin. Shows it in use; gives data on properties, thermal conductivity. Gustin-Bacon Mfg. Co.

281 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Also gives detailed information on accelerators, thinners, primers. Goodall Rubber Co.

282 Fluid Drive — Of value to power engineers interested in obtaining adjustable speed operation in a range from 100 to 2500 hp is 24-pp Bulletin 9319, illustrated in color. Covers company's Type VS, Class 4 Gyrol fluid drive, explaining its principle of operation and illustrating its use. American Blower Corp.

283 Steam Condensers — Some recent additions to this company's power plant condenser installations are pictured and described briefly in this 24-pp booklet. Also included are an engineering section on condenser design factors, and sections devoted to air removal equipment to steam condenser specialties, and to maintenance services available. Condenser Service & Engineering Co., Inc.

284 High Temp Compound — This folder describes Thred-Gard, a high temperature compound designed to eliminate seizing and galling and lubricate threaded surfaces. Tells its use as thread lubricant and in other applications in power plants, refineries and chemical plants, steel mills, others. Crane Packing Co.

285 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

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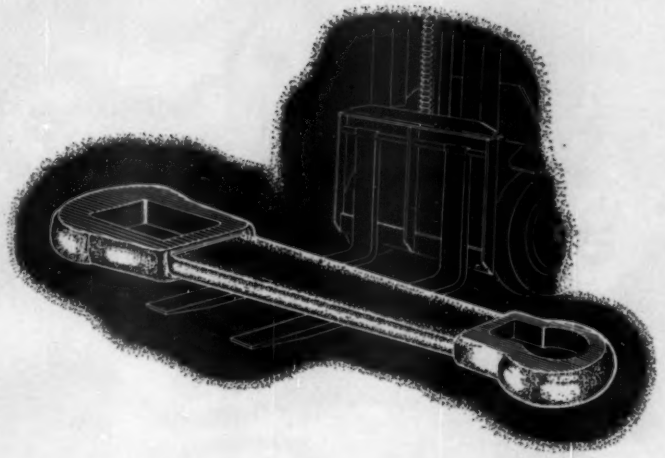

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HELPFUL BULLETINS

continued from page 32

157 Water Softeners — Troubles caused by hard water and the multiple economies effected by curing them are discussed in 20-pp Bulletin 2386-A. Lists industries where steam and water are of importance. Specifications, operating characteristics and typical installation photos are included. The Permutit Co.

159 Waste Water Reclamation — Technical Reprint T-129, 6-pp, discusses treatment of sewage plant effluent for water reuse in process and boiler feed, examining current developments and design factors of water. Typical plant layouts and result sheets are shown and discussed, cost factors are considered, and applications described. A bibliography is included. Graver Water Conditioning Co.

OTHER EQUIPMENT

160 Residual Fuel Oil Handling — A concise presentation on how to heat and handle heavy fuel oil for use in the burners of boilers, furnaces and processing equipment is presented in 8-pp illustrated Bulletin 1601. A three-step procedure is detailed — heating the oil in the storage tank; heating the oil in the piping system, and heating the oil for burning. Preferred Utilities Mfg. Corp.

161 Liquid Receivers — Bulletin LR-1 provides data on liquid receivers for ammonia and Freon. Gives sizes, capacities, information on connections. Also includes data on cast iron receiver stands. Henry Vogt Machine Co.

163 Protective Coatings — Bulletin 7-2, 12-pp, describes selection and use of company's protective coatings, featuring Neobon, Neelium, Zerok 110 and Zerok 101, and Nepoxide. Product descriptions, chemical data, and applications are offered for each of the coatings. An accompanying reprint gives additional information on laboratory and plant evaluations of liquid neoprene coatings. The Atlas Mineral Products Co.

164 Standard Boilers — Eight-pp Bulletin WT-8 describes company's "S" series of boilers with capacities ranging from 10,800 to 50,000 lb. Lists data and specifications on each of the models and sizes and discusses general design features and special "S" type construction features. Wm. Bros Boiler & Mfg. Co.

165 Non-Ferrous Forgings — Various types of forgings produced by the company from non-ferrous forgings materials including copper, copper base alloys and aluminum alloys are illustrated in this 6-pp bulletin. Forgings data, including nominal composition of the alloys, typical mechanical properties, electrical conductivity, commercial tolerances, and government and engineering society specifications given. Forgings Div., Scovill Mfg. Co.

166 Unit Heaters — Construction, application, selection and performance data on gas-fired unit heaters are presented in 12-pp Bulletin 655. Cutaway and outline drawings illustrate features of the heat exchanger, the burner and other component parts, dimensions, weights, capacities, and suggestions for locating unit heaters are covered in detail. Modine Mfg. Co.

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By WILLIAM B. ANDERSON *

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Subsequent development toward improved inducer design, high impeller tip speeds and straight-channel-type diffuser has raised compressor performance to 7:1 pressure ratio at 75 to 80 per cent efficiency. Specific fuel consumption has been reduced from 1.8 lb per hp-hr to 1.0 lb per hp-hr, and 0.7 lb per hp-hr is anticipated.

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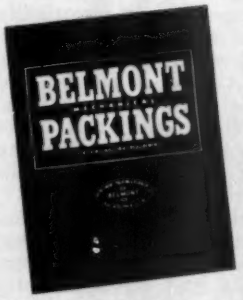

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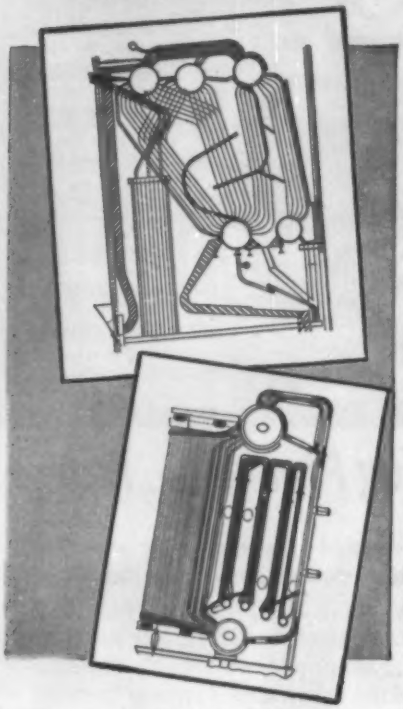

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Use and Misuse of Filming Amines in Steam Cycles

By J. F. WILKES *
DR. W. L. DENMAN **
and DR. M. F. OBRECHT †

CONTAMINATION of steam by oil or boiler water carryover decreases filming amine effectiveness. The detrimental effect of oil may result from desorption mechanisms. Since moderate increase in pH values enhances the effectiveness of filming amines, it is unlikely that boiler water alkalinity contributes to observed detrimental effects. Other inorganic anions may displace absorbed amine molecules by a reaction similar to ion exchange.

Filming amine salts such as octadecylamine acetate must not be mixed with other water treating chemicals. Such mixtures will cause immediate formation of sticky precipitates, which clog mixing and pumping equipment.

Application of filming amines ahead of open feedwater heaters, closed heat exchangers, or economizers should be avoided. Filming amines may contribute to deposit formation in the presence of other contaminants.

Excessive feed rates at the start of filming amine treatment may cause excessive maintenance and service interruptions, by accelerated fouling of traps, screens, and pumps with displaced corrosion deposit agglomerates.

Processes such as bonderizing, electroplating and mirror silvering, which require chemically clean surfaces, may be adversely affected by presence of filming amines in condensate used for rinse operations.

In isolated instances, filming amine treatments have been reported to cause erratic operation of electrically operated liquid level controls, through film formation on electrode surfaces. This changes the cell constant, and produces misleading indications. Methods of eliminating this latter difficulty by removal of filming amines ahead of conductivity cells are being studied.

Filming amine treatment of steam improves heat transfer rate in heat exchangers, both by eliminating corrosion deposits and by apparently promoting dropwise condensation of steam. When transferring heat to certain liquids, or materials such as wet paper, substantial increases in heat transfer efficiency may be realized. However, careful analysis of the heat transfer system is necessary before one can economically justify the use of these materials on the basis of improved heat transfer.

* Director, Research and Product Development, and ** Directing Chemist, Dearborn Chemical Company, Chicago, Illinois. † Department of Chemical Engineering and Water Consultant, Michigan State College.

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Series Capacitors Eliminate Voltage Fluctuations in Industrial Plants

By T. H. McGREER *

MODERN MANUFACTURING methods require good voltage regulation, yet many processes cause intermittent, but severe voltage fluctuations.

Series capacitors are often the best and most economical solution, and in this paper, the author argues a strong case in their favor.

Briefly, the principle of series capacitor operation is to place capacitor in series in the line sized so that the capacitive reactance is approximately equal to the series inductive reactance that it is desired to cancel.

The author describes in detail the method of determining correct capacitor, and deals fairly with the difficulties associated with this method. At the end of the paper he makes the following conclusions:

1. The series capacitor is often the most economical solution to a serious voltage problem.
2. It is effective against steady-state voltage drops but is usually economical only as a remedy for rapidly fluctuating voltage conditions where a regulator is ineffective.
3. It is the only solution that can be used to completely eliminate voltage fluctuations at a load point such as at B in the example.
4. It must be located with care to prevent undesirable voltage rises.
5. It requires suitable protective equipment.
6. Occasionally it gives rise to serious low frequency resonant conditions that are almost universally remedied by a resistor.
7. Carefully applied, it is a most useful device and deserves more use than has been made of it in industrial practice.

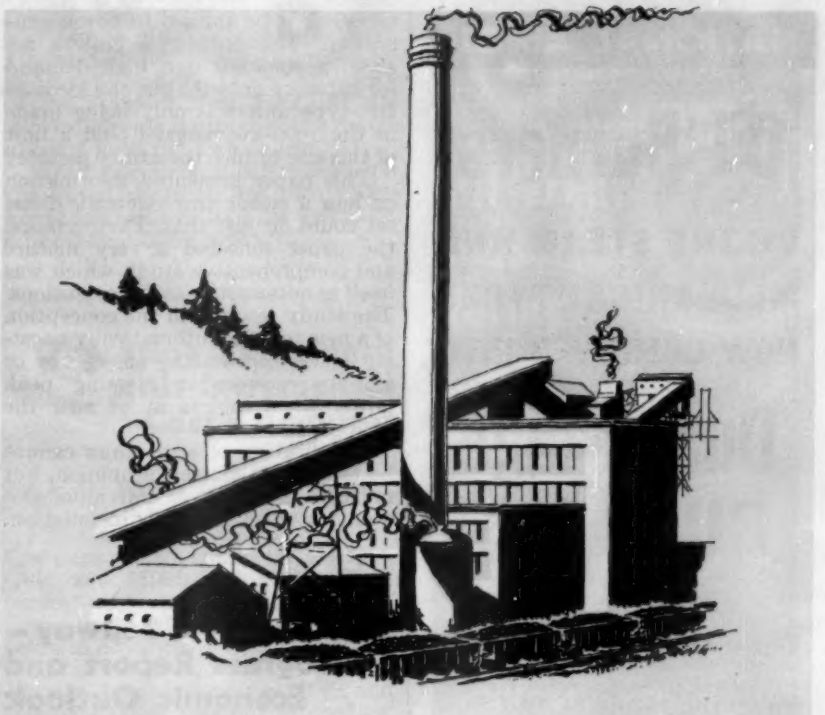
* Sargent and Lundy, Engineers, Chicago.

Mobile Electric Automatic Generating Equipment for Utilities

By E. A. ARMSTRONG *
and K. O. BOWER †

ORIGINALLY, the idea to build mobile diesel generating equipment for the utilities took form at Electro-Motive Division of G-M when a utilities executive inquired whether or not the first-cost and operating economies of diesel-electric locomo-

* Consultant.
† A.C. Control engineer, Electro-Motive Division, G-M, La Grange, Ill.



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tives might be applied to power generation. The industry's growth assured a constant and high demand for capacity growth, but the locomotive-type unit was only being made in the 1000-kw range. Could a unit of this size fit into the utility picture?

This paper presented information on how a *mobile* and *automatic* diesel set could do just that. Furthermore, the paper reflected a very mature and comprehensive study which was itself as noteworthy as its conclusions. The study resulted in the conception of a new tool for automatically boosting voltage, providing emergency or standby power, or meeting peak power requirements at or near the load center.

Justification of such units cannot be taken as a matter of opinion, but must be the result of individual economic studies for each installation.

St. Lawrence Seaway—Progress Report and Economic Outlook

By RAYMOND F. STELLAR *

HYDRAULIC INFORMATION about the Great Lakes–St. Lawrence basin is given in the first part of this paper. Figures are quoted to show where the large drops in head occur along the river, and depths, flows, and other general information is given about the five great lakes and existing channels between the lakes and along the existing waterways.

The following figures for 1953 commerce at a few selected ports are interesting:

	Tons
Duluth-Superior	77,000,000
Chicago	38,000,000
Toledo	32,000,000
Buffalo	22,000,000
Detroit	25,000,000
Cleveland	23,000,000
Ashtabula	15,000,000
Milwaukee	8,000,000
New Orleans	40,000,000
Baltimore	42,000,000
New York	139,000,000

The power development will include a semi-outdoor powerhouse 3230 ft long, to extend from the lower end of Barnhart Island, in the International Rapids Section, near Massena, New York, to the Canadian mainland, and a spillway dam 1800 ft long connecting the upper end of the island with the U. S. mainland.

Average ultimate head at the powerhouse will be about 85 ft. Average flow is about 240,000 cu ft per sec ranging from 323,000 cfs to 154,000 cfs. The powerhouse will have 32 generators with an aggregate installed capacity of 1,880,000 kw. Annual generation will average 13 billion

* Engineer, St. Lawrence Seaway Development Corporation.

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FIG. 17-28 Cylinder

FIG. 215 Flanged

FIG. E-57 Double Window

FIG. 212 Visibility Welding Neck or Screw

FIG. E-811 Flapper

FIG. E-1810 Rotating Wheel Type

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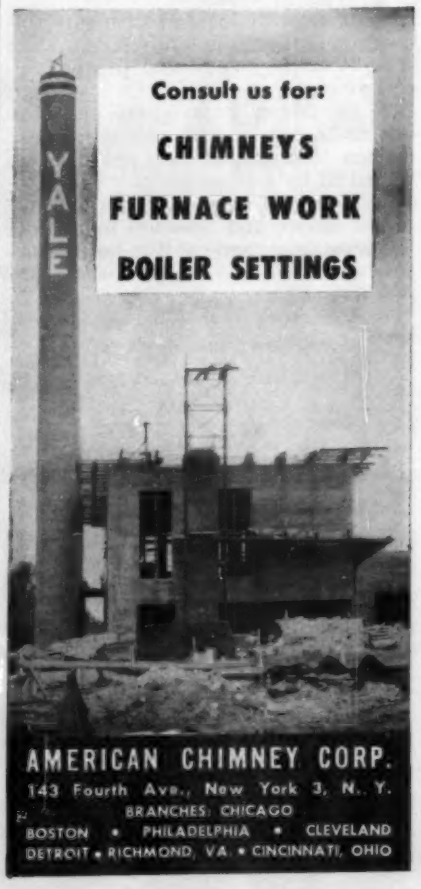

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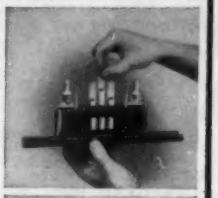

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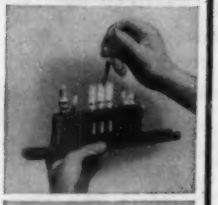

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kwh, to be divided equally between Hydro-Electric Power Commission of Ontario and the Power Authority of the State of New York. At site generation cost is expected to average about 4 mills per kwh or less.

Work has already commenced on the initial contracts for the powerhouse and spillway dam, as well as on a number of other items.

Operating Experience with Incremental Cost Computer

By E. D. EARLY *

PRIOR TO June, 1954, the Southern Company system (Alabama, Georgia, Gulf, and Mississippi Power Companies) was coördinated in its operation by schedules prepared 12 to 24 hours in advance.

In June of 1954, however, the new concept of continuous evaluation and load scheduling was put into effect. The speaker developed the principle of operation for a simple, compact, easily-operated analog computer which was subsequently designed and built by Leeds and Northrup. Its object was to determine the proper loading of each generator in the system for the minimum *system* power supply cost, while giving consideration to minimum generation requirements for area protection. That this is not a simple task is indicated by the fact that the machine must solve 30 nonlinear simultaneous equations, each of which has some 30 variables, plus maximum and minimum values for generation of each unit. The size and complexity of the unit was decreased by making the power system itself a part of the computer. Though the system is designed to automatically load each generating unit at its optimum generation, it will not go on full automatic duty until 1956 — and then only for 4 to 8 steam plants with 1- to 1.8-million kw capacity.

It should be remembered that this computer is primarily concerned with the *cost* of delivered power, therefore the cost of fuels at the different plants is as important in its calculations as the heat rates, transmission losses and location of loads.

"Early Bird," as the computer has been named, has proved itself effective by holding the incremental cost of delivered power from all sources operating within their regulating range equal to within + 0.1 mill. It was expected that minimum savings would amount to $25 per hour over what could be achieved merely with good practice. Experience shows savings of $20 (peak load) and $40 (valley) per hour, or not less than $200,000 per year.

* Manager, Southern Company Power Pool.

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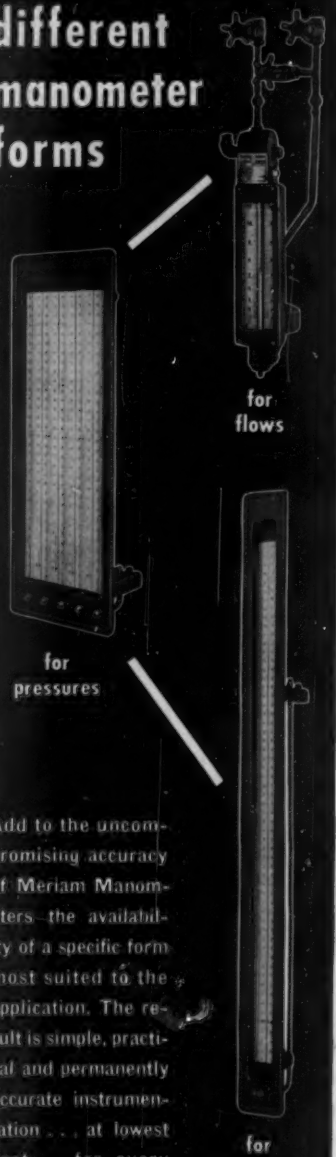

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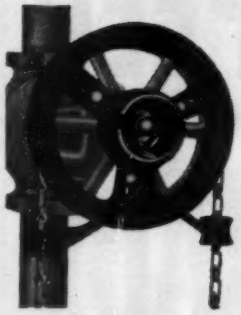
Protect Your Manpower with...

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

Control out-of-reach overhead valves right from the floor! No more climbing on ladders, balancing on boilers, perching on workbenches or machines. Prevent accidents and costly claims — also save fuel, steam and money.

Only four simple, quickly-assembled parts installed and operating in only a few minutes, Babbitt Adjustable Sprocket Rim with Chain Guide —



- **Fits all valve wheels**
- **Simplifies pipe layouts**
- **Eliminates risky climbing**

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

Call your Industrial Distributor. He carries complete stocks.

Babbitt STEAM SPECIALTY CO.

4 BABBITT SQUARE, NEW BEDFORD, MASSACHUSETTS

For more data circle 570 on Post Card

YOUR FINGER IS ON THE PULSE OF YOUR BOILERS with *ELLISON* DRAFT GAGES ON THE JOB!

Proper combustion of fuels is dependent upon draft—Ellison Gages show you the draft condition at all times—they are easier to read, accurate, dependable.

Straight-line and Dial types—bell actuated and diafram actuated—built for durability and accuracy. Exclusive features such as translucent glass scale, unitized mechanism that can be slipped out of case, practical illumination, nonfogging and dust sealed. A bank of Ellison Straight-Line Draft Gages at the South Shore Destructor Plant, Brooklyn, N.Y., is shown. Send for Bulletins 122 and 124.

ELLISON DRAFT GAGE CO., INC.

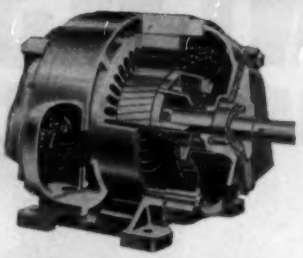
550 W. MONROE ST. Since 1896 CHICAGO 6, ILL.

The Ellison Line Also Includes:

Draft Gages, Bell and Diafram—Inclined Draft Gages—Portable Inclined Vertical Tube Gages—Vertical Tube Gages—Oil, Heavy Liquid and Mercury—Single and Multi-Tube-Saturator Gages—U Gages—Stationary and Portable—Air Filter Gages—Dial and Inclined Tube Types—Pitot Tubes—U Path Steam Calorimeters—Portable Gas Analyzers-Orsat Type

For more data circle 571 on Post Card

Asbestos- Protection gives longer life to every U.S. MOTOR



Asbestos, Nature's only incombustible fiber, insulates U.S. motor windings. Asbestos effectively resists burnouts because it will withstand high operative temperatures, *proved by 30 years of performance*. Materials commonly used for insulation will carbonize, whereas *asbestos* remains invulnerable to heat attack; hence *longest life!*

1
"What's cookin'?"
"The U. S. stator is pre-baked several hours to drive off every trace of moisture before insulating."
2
"What's the dunkin' for?"
"The stator is vibro-dipped in Asbestosite; wires electrically vibrated distribute insulation."
3
"Are you bakin' it again?"
"The second baking is applied for 12 hours to season Asbestosite and position wires."
4
"You already dipped it once."
"A second dip into the Asbestosite bath is made, to build up thickness of insulation."
5
"Nothing half-baked about this, is there?"
"Right! A third baking cures the second coating to further protect windings."
6
"Now what?"
"Windings are gun-sprayed with Asbestosite to form a smooth surface."
7
"Here we go again!"
"Yes, further baking for 3 hours hardens the coating to more completely protect windings."
8
"Here comes the gun again!"
A final spray of asbestos compound is applied to provide very hard moisture-resistant finish."
9
"This is where I came in."
"A fifth and final bake of 12 hours insures impervious surface of coil insulation."

Exclusive in all U.S. MOTORS

For Booklet(s) showing advantages of Asbestos-Protection in Varidrives, Uniclosed Motors, Totally-Enclosed Motors or Syncrogear Motors write: Dept. PE-5

U.S. ELECTRICAL MOTORS Inc.

P. O. Box 2058, Los Angeles 54, Calif. or Milford, Conn.

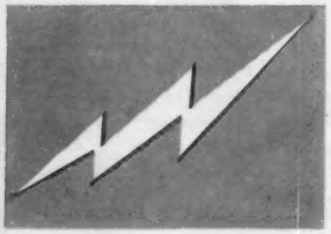
For more data circle 572 on Post Card

NEWS IN TEMPERATURE MEASUREMENT AND CONTROL!

HAGAN MODEL "P" AMPLIFIER SETS NEW RECORDS FOR

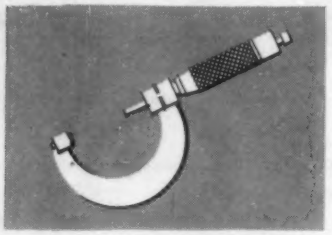
SPEED

FULL SCALE RESPONSE IN 0.1 SECOND



ACCURACY

PLUS OR MINUS ¼% OF INPUT RANGE

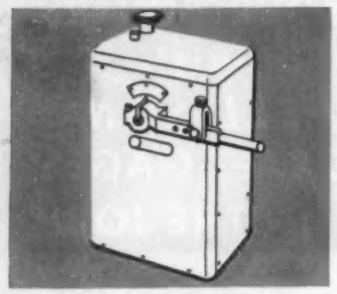


LOW MAINTENANCE

NO SLIDE WIRES — NO REVERSING MOTORS

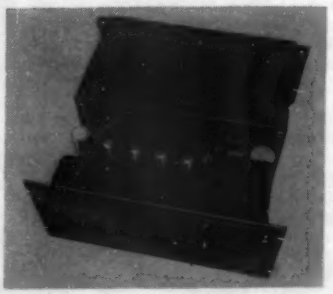
CONTROL

WITH HAGAN ELECTRO-PNEUMATIC CONVERTER



The Hagan PowrAmp Model "P" DC Amplifier boosts over-all steam plant efficiency by making possible more precise temperature control. Use the Model "P" *to control* . . . reheat steam temperature . . . superheat steam temperature—*to measure* . . . flue gas temperature . . . tube metal temperature . . . electrical power . . . pressure.

Because of its feedback stabilized circuit and its drift-free linearity, the Model "P" provides the steam plant operator with a new and highly efficient method of temperature measurement and control.



HAGAN POWRAMP
MODEL "P" DC AMPLIFIER

Send for Hagan Bulletin MSP 111.1 for the full story on this versatile and money-saving instrument.

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Aeronautical and Automotive Testing Facilities

For more data circle 573 on Post Card

Fewer Parts Mean Greater Dependability

Floorstand Motor Unit . . . control panel, motor, limit switch and push button station.

Simple, durable mechanism of Chapman's Motor Unit. Handwheel remains stationary during motor operation.

IN CHAPMAN MOTOR UNITS

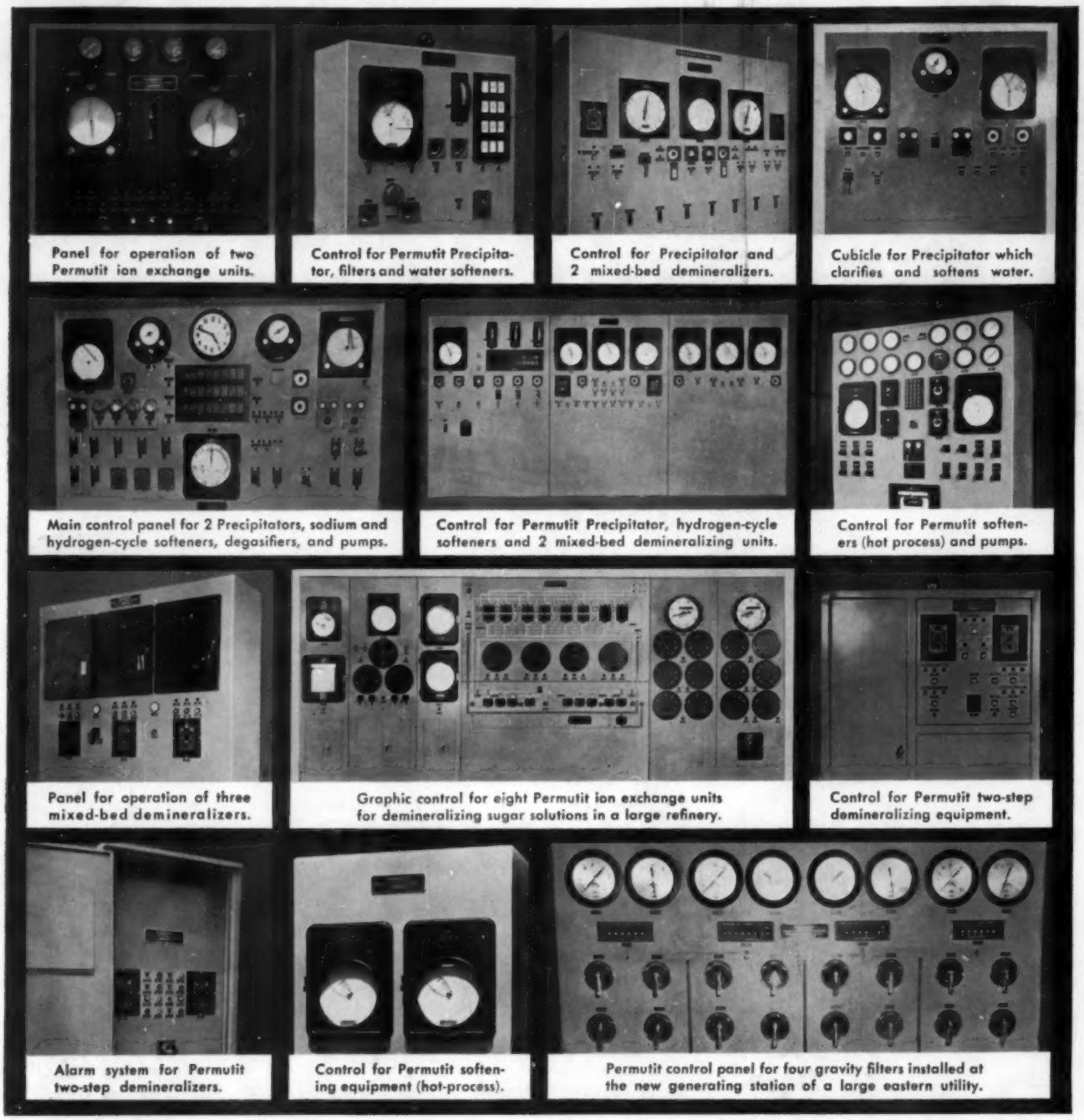
Chapman's simple and rugged Motor Unit gives accurate, trouble-free control of large valves and sluice gates. It has approximately *half as many parts* as any other unit. Its simplified design, low speed motors and low-ratio, stubtooth gears combine to give positive operation without drift, in *any* position and under all conditions.

Installation is fast and simple. The floorstand unit comes completely wired, ready to connect to leads. Limit switch has micrometer adjustment for exact pre-setting for seating tightness. Motor Units operate smoothly under the most adverse conditions. All units are weather-proof and steam-tight. Write today for *new* Catalog 51.

The Chapman Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

For more data circle 574 on Post Card



Panel for operation of two Permutit ion exchange units.

Control for Permutit Precipitator, filters and water softeners.

Control for Precipitator and 2 mixed-bed demineralizers.

Cubicle for Precipitator which clarifies and softens water.

Main control panel for 2 Precipitators, sodium and hydrogen-cycle softeners, degasifiers, and pumps.

Control for Permutit Precipitator, hydrogen-cycle softeners and 2 mixed-bed demineralizing units.

Control for Permutit softeners (hot process) and pumps.

Panel for operation of three mixed-bed demineralizers.

Graphic control for eight Permutit ion exchange units for demineralizing sugar solutions in a large refinery.

Control for Permutit two-step demineralizing equipment.

Alarm system for Permutit two-step demineralizers.

Control for Permutit softening equipment (hot-process).

Permutit control panel for four gravity filters installed at the new generating station of a large eastern utility.

Why we make our own panels:

Life might be simpler if we "farmed out" our control cubicles and instrument panels . . . but we like to build *every* major component of a PERMUTIT water-conditioning or ion exchange system . . . so that we know it will do its specific job properly.

That's why these panels . . . and the hundreds of others in power plants, chemical process plants, manufacturing plants and municipal water works . . . are designed by Permutit engineers and assembled, wired and piped in Permutit factories.

That's why we design and build our own special parts such as multiport valves, strainer systems and chemical feeders. That's why we make our own ion exchange resins.

As a result, we talk in terms of over-all results. And you get *complete* service from *one* source.

For further information, write to: The Permutit Company, Dept. PE-5, 330 West 42nd St., New York 36, New York.

WATER CONDITIONING • ION EXCHANGE

PERMUTIT®

For more data circle 575 on Post Card